Volume 083
Article **08**

FISHERY RESEARCH

AN EVALUATION OF CUTTHROAT TROUT PRODUCED IN PRIEST LAKE TRIBUTARIES

Job Completion Report
Project F-71-R-12
Subproject III, Job No. 1

By

R.M. Strach and T.C. Bjornn
Idaho Cooperative Fish and Wildlife Research Unit
University of Idaho, Moscow, ID 83843

March 1991

Table of Contents

List of Tables

Table Page

List of Figures

List of Figures (continued)

Abstract

Stocking of cutthroat trout *Onchorynchus clarki lewisii* fry in streams with no fish (Cache Creek), or with only low numbers of cutthroat trout present (Packer and Zero Creeks) resulted in increased densities of age-I fish. Fry stockings in the following one to four years did not increase the densities of age-I fish further, perhaps because the carrying capacity for all age classes combined had been reached. In Blacktail Creek, a stream with brook trout *Salvelinus fontinalis,* the density of age-I cutthroat trout was not increased following the introduction of fry. The greatest opportunity for increasing densities of stream-dwelling cutthroat trout by stocking with hatchery fry is in creeks with either no fish present (Cowley 1987; Irving 1987; Miller 1958) or with only cutthroat trout present. Packer and Zero Creeks, each with a passage barrier near their mouths, responded to fry stocking with an upward trend in total biomass of cutthroat trout from 1984 through 1988.

All creeks were closed to angling in 1982 to prevent the harvest of juvenile and adult cutthroat trout. Significant increases in density were found for age-II and older cutthroat trout in Lion and Two Mouth Creeks, and for age-I cutthroat trout in Two Mouth Creek in 1983; little further increase occurred in subsequent years. The abundance of age-I or -II and older cutthroat trout did not change significantly in the other unstocked creeks as a result of the fishing closure.

Introduction

The cutthroat trout *Onchorynchus clarki* population in Priest Lake and its tributaries has declined in abundance over the past 70 years. A number of factors have contributed to the decline, including: introductions of exotic fishes and invertebrates, overharvest of the fish stocks, and deteriorated habitat in streams. As part of a broad-scale effort to determine if cutthroat trout abundance could be increased, Idaho Cooperative Fish and Wildlife Research Unit personnel conducted studies in the tributaries of the lakes from 1982 through 1989. These studies were designed to answer the following questions:

1. How many and what species of fish were present?
2. How much habitat was available?
3. Could we increase cutthroat trout abundance by stocking fry?
4. Could streams now containing primarily brook trout *Savelinus fontinalis* be converted back to cutthroat trout production by repeated fry stocking?
5. Would hatchery cutthroat trout fry live in streams where brook trout had been removed or no fish were present?
6. Would a closure to angling in the tributaries increase the abundance of juvenile cutthroat trout?

The results of some of the studies (mainly questions 1 and 2) were reported in theses by Irving (1987) and Cowley (1987).

Objectives

The specific objectives addressed in this report are as follows:

1. To determine if creeks dominated by brook trout can be converted back into cutthroat trout production by stocking cutthroat trout fry.

2. To determine if cutthroat trout fry will become established in a stream where brook trout have been removed.

3. To determine if densities of cutthroat trout in underseeded creeks can be increased by supplementation with hatchery fry.

4. To evaluate the effect of closing tributaries to angling on the density of cutthroat trout.

Study Area

Priest Lake is located in northern Idaho 32.2 km (20 mi) south of the Idaho-British Columbia border and 48.3 km (30 mi) north of the town of Priest River, Idaho. The drainage includes Upper Priest Lake, connected to Priest Lake by a river referred to as a thoroughfare, and 16 major tributaries that flow into the lakes (Figure 1).

The upper Lake is about 5.1 km (3.2 mi) long, 1.6 km (1.0 mi) wide and 29.9 m (98 ft) deep. The lower lake is about 29.8 km (18.5 mi) long, 7.2 km (4.5 mi) wide, and 108.2 km (355 ft) deep (Bjornn 1961). Both lakes are oligotrophic. The west-side of the drainage is primarily federal land adminis- tered by the USDA Forest Service, and the east-side is state land administered by the Idaho Department of Lands.

The Priest Lake drainage is home to native and introduced fishes. Indigenous fishes include westslope cutthroat trout, bull trout *Salvelinus confluentus,* northern squawfish *Ptychelius oregonensis,* and Mountain whitefish *Prosopium williamsonii.* Some introduced fishes include kokanee salmon *Onchorhynchus nerka,* brook trout, lake trout *Salvelinus namaycush* (Bjornn 1961), and tench *Tinca tinca,* which were observed in 1987.

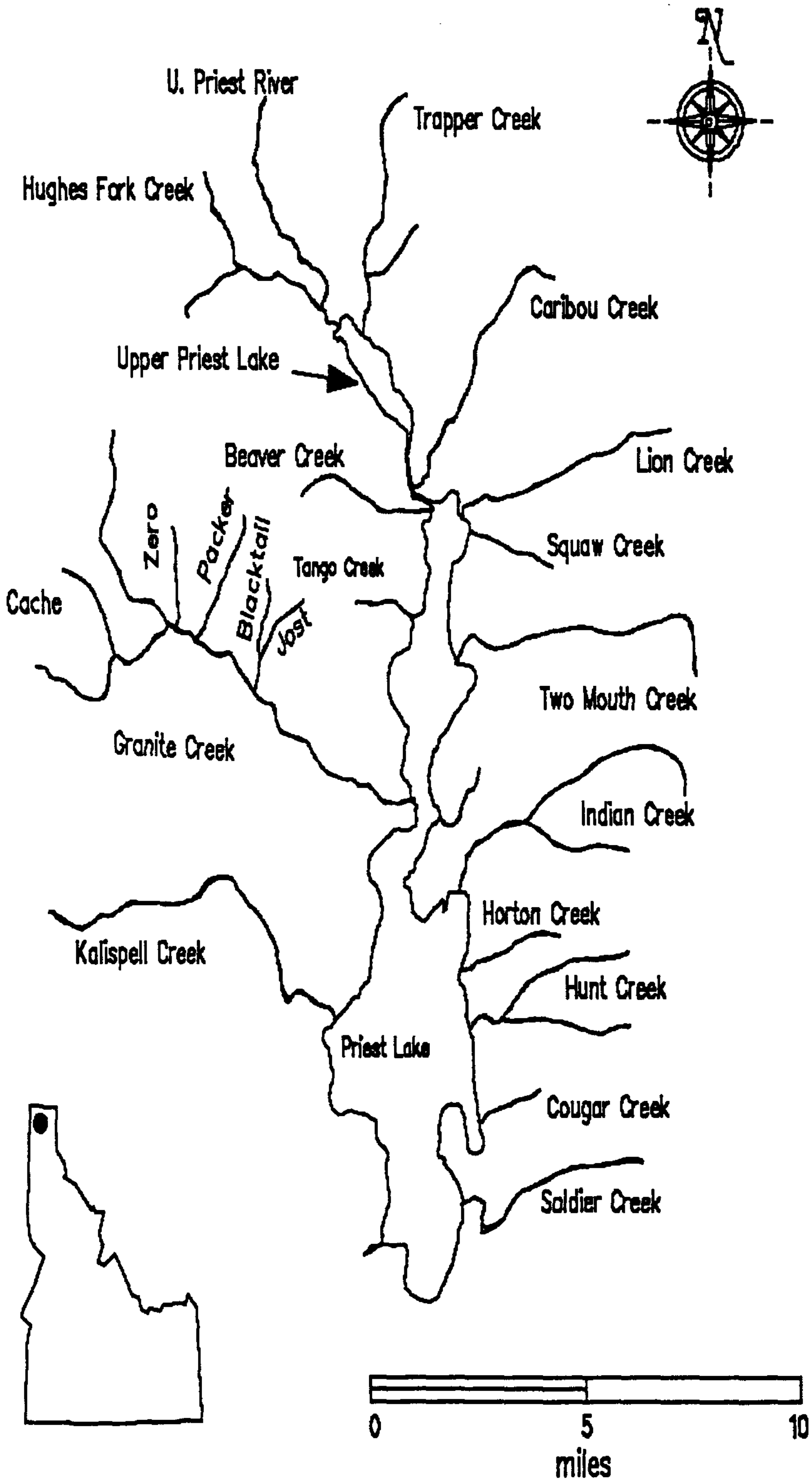


Figure 1. Map of Priest Lake and tributaries located in northern Idaho and northeastern Washington.

Methods

General methods common to all objectives

The study pools in tributaries to Granite Creek were spaced equally throughout the length of each creek (Irving 1987; Cowley 1987). Each pool was marked with flagging tape and located by hiking from the mouth of each stream to its source. Fish were counted in the pools with snorkeling gear before cutthroat trout fry were stocked, and one and four weeks after stocking. Fish densities were obtained by dividing the number of fish counted of each age group by the area (m^2) of each study pool. Numbers density (fish/m^2) was then converted to biomass density (grams/m^2) by multiplying the number of fish in each age group by an estimated weight.

A meter stick divided into three increments of 0-50 mm, 51-100 mm, and 100 mm and greater was used to place the observed fishes into size classes. Cutthroat trout fry usually fell into the first length class, while age I and age II and older fish fell into the latter two length classes, respectively, (Bjornn and Mallet 1964; Lukens 1978; Griffith 1972; Lewynsky 1986).

Cutthroat trout fry were transported in a 1150-liter tank truck from the Clark Fork Fish Hatchery and stocked at a rate of 5-10 fish/m^2 (Irving 1987). The number of fry stocked was estimated volumetrically using a 1-liter graduated plastic flask. Fry were placed in 5-gallon plastic buckets or oxygen filled plastic bags for transport from the truck to the streams. The oxygen filled plastic bags were placed in a backpack and transported by motorcycle to less accessible stocking sites. Water temperatures were measured in the fish truck, in each study stream, and adjusted in the truck, if necessary, to avoid thermal shock. In both transportation methods, fry were distributed along the shoreline and placed about 100 m up and downstream from each stocking location.

The General Linear Model procedure was used to fit regression lines (a=0.05) to densities of age-I, -II, and older, and total (0, I, II and older) cutthroat and brook trout from 1983 to 1989 for all creeks snorkeled. Tukey's (HSD) test was run (a=0.10) for each age class by species for stocked streams within the Granite Creek drainage. Confidence intervals (95%) were also calculated for each age class by year (Appendix A); represented as a vertical line in Figures 4-11.

Stocking cutthroat trout in streams with brook trout

To determine if a stream containing mostly brook trout could be converted to one containing mostly cutthroat trout, cutthroat trout fry were stocked in streams with brook trout for five consecutive years. Blacktail and Jost Creeks contained both cutthroat and brook trout throughout the length of each stream. Fry were stocked in Blacktail Creek each year starting in 1984 and continuing through 1988, and in Jost Creek in 1981 and 1984 (Table 1). In 1984, Irving (1987) snorkeled nine pools in Blacktail Creek to assess the density of fish present. The number of snorkel sites was increased to

10 pools throughout the length of Blacktail Creek in 1985 and 1986 (Cowley 1987) and remained at 10 pools in 1987, 1988, 1989. In 1984, Irving (1987) snorkeled six pools in Jost Creek. This number was increased to 20 pools distributed throughout the entire length of Jost Creek in 1985 and 1986 (Cowley 1987) and remained at 20 in 1987 and 1988.

Jost Creek flows into Blacktail Creek about 0.7 km upstream from its confluence with Granite Creek and both streams contained similar fish communities at the onset of the study in 1983. Jost Creek was held as an experimental control, except in 1981 and 1984, and Blacktail Creek

Table 1. Number of cutthroat trout fry stocked from 1981 and through 1988 in tributaries of Granite Creek. Ns= not stocked.

Year	Blacktail Creek	Cache Creek	N.F. Granite Creek	Packer Creek	Zero Creek	Jost Creek
1981	127,600	ns	340,400	46,400	81,200	11,600
1982	ns	ns	ns	ns	ns	ns
1983	ns	ns	ns	ns	ns	ns
1984	117,857	ns	ns	102,701	ns	64,196
1985	106,807	ns	ns	ns	98,449	ns
1986	65,880	58,417	ns	ns	ns	ns
1987	120,456	99,608	172,985	117,740	89,645	ns
1988	118,000	97,000	481,861	113,608	90,485	ns

was stocked for five consecutive years. The stocking program in Blacktail Creek was an attempt to fill all unoccupied niches with hatchery cutthroat trout and to determine if increased numbers of cutthroat trout could overwhelm and out-compete the brook trout.

Cutthroat trout in streams with brook trout removed

To evaluate the ability of cutthroat trout to colonize streams where brook trout were removed, all fish were removed from Cache Creek and then the stream was restocked with cutthroat trout fry. Cowley (1987) selected 21 pools throughout Cache Creek as snorkel sites. The pools were distributed throughout the length of Cache Creek and varied in size, depth, and gradient. Headwater pools were accessed by hiking up the stream bottom or driving a motorcycle on parallel trails.

In 1986, sodium cyanide was added to Cache Creek to facilitate the removal of the fish. Before the chemical application and after neutralization, the abundance of fish was monitored by snorkeling in the transect pools.

Following the removal of fish in 1986 and in the three years 1986-1988, cutthroat trout fry were stocked (Table 1) at a rate of approximately five fish/m^2, and their subsequent abundance was monitored by snorkeling each year through 1989. The same 21 pools were snorkeled, fish were identified, counted, measured, and data were recorded.

Stocking cutthroat trout fry in underseeded streams

To determine if the abundance of cutthroat trout could be increased by stocking fry, fish were stocked in Packer and Zero Creeks, streams with only cutthroat trout present (Table 1). Both Zero and Packer Creeks had fish migration barriers near their mouths preventing brook trout from expanding its range into these tributaries. Each creek was stocked upstream from the barriers when cutthroat trout fry were available. Zero Creek was stocked in 1984, 1985, 1987, and 1988, and Packer Creek was stocked in 1984, 1987, and 1988 (Figure 2).

The abundance of fish in Packer Creek was observed by snorkeling seven pools in 1984 (Irving 1987), 19 pools in 1985 and 20 pools in 1986 (Cowley 1987), and 25 pools in 1987, 1988 and 1989. In Zero Creek, Cowley (1987) snorkeled 20 and 29 pools in 1985 and 1986, and we snorkeled 27 and 25 pools in 1987 and 1988, respectively.

Pools were selected throughout the length of each stream, and for Packer Creek, were accessed by hiking up the center of the stream. Pools were also accessed in this way for the lower third of Zero Creek, but pools in the upper two-thirds were accessed using a motorcycle on an old Forest Service road.

Cutthroat trout densities in streams closed to angling

To determine if the abundance of cutthroat trout increased following the elimination of juvenile harvest, fish densities were monitored in tributaries closed to angling. Reaches 100 m in length were established in large tributaries in 1982, and snorkeled to determine species composition, age, and abundance of fish. Cowley (1987) re-snorkeled these study sections in 1986. In 1983 and 1984, Irving (1987) snorkeled pools in some of these unstocked creeks closed to angling.

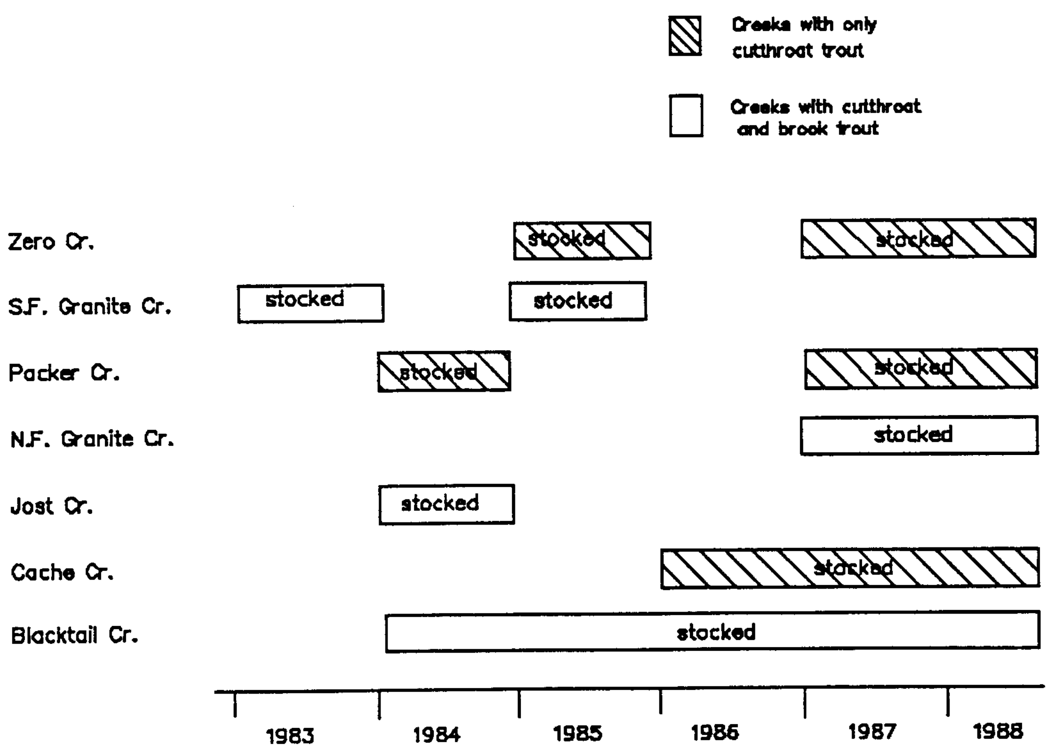


Figure 2. Creeks that were stocked with cutthroat trout fry from 1983 to 1988 and the fish community present.

In 1987 and 1988 study sections were changed to include either two, one-half mile reaches with five pools per reach or a one mile reach with ten pools (Appendix B). Two reaches were selected in creeks that were long and hydrologically diverse, and in creeks that were shorter and relatively homogeneous, a one mile reach was selected. The surface area of each pool was calculated multiplying the mean of three widths by the length of the thalweg. These methods were selected to facilitate future fish monitoring studies.

At least one boundary for each reach was established at a landmark such as a bridge, road intersection, or a Forest Service trial (Appendix B). After one boundary was established, the truck odometer was used to measure the reach length (in cases where the road paralleled the stream). Other stream reaches were measured using a Forest Service Travel Map and recognizable landmarks such as the mouths of lateral tributaries or trail crossings. The number of pools in each study reach was counted and the total divided by the number of pools to be snorkeled (either five or ten depending on the reach length) to determine the proportion of pools to be snorkeled.

Results

Stocking cutthroat trout *fry in streams with brook* trout

In Blacktail Creek, there was a significant trend toward increased numbers of both cutthroat and brook trout of all ages from 1983 to 1989 (Table 2). Slopes of regression lines of fish density over time were all positive and significantly different (a=0.05) from zero. None of the differences in density between years were significant (a=0.1) for age-I

Table 2. Mean densities (fish/m^2) of age-0, -I, -II, and older cutthroat trout, and total cutthroat and brook trout numbers in Blacktail and Jost Creeks in late summer, mean area of habitat units (m^2), and the number of habitat units snorkeled from 1983 through 1989. Underscored years indicate that cutthroat trout fry were stocked.

Creek Year	Number of habitat units	Area of habitat units (m^2)	Cutthroat trout 0	Cutthroat trout I	Cutthroat trout II+	Cutthroat trout Total	Brook trout 0	Brook trout I	Brook trout II+	Brook trout Total
Blacktail										
1983	26	18.47	0.010	0.009	0.020	0.040	0.003	0.004	0.003	0.010
1984	9	25.13	0.000[a]	0.009	0.013	0.023	0.013	0.006	0.018	0.037
1985	10	11.12	0.403	0.050	0.017	0.469	0.067	0.014	0.017	0.098
1986	10	12.01	0.455	0.045	0.045	0.545	0.086	0.061	0.087	0.234
1987	10	14.58	0.334	0.045	0.102	0.480	0.120	0.018	0.066	0.204
1988	9	11.70	0.202	0.023	0.193	0.418	0.086	0.134	0.206	0.425
1989	10	11.91	0.144	0.077	0.085	0.306	0.047	0.014	0.022	0.084
Jost										
1983	52	11.27	0.008	0.021	0.000	0.029	0.021	0.036	0.050	0.108
1984	6	10.59	0.000	0.000	0.000	0.000	0.032	0.058	0.085	0.175
1985	19	2.97	0.081	0.178	0.000	0.258	0.035	0.111	0.063	0.209
1986	19	2.97	0.097	0.016	0.066	0.178	0.027	0.062	0.130	0.219
1987	20	3.15	0.000	0.026	0.153	0.180	0.041	0.118	0.113	0.272
1988	20	2.92	0.000	0.000	0.015	0.015	0.000	0.107	0.090	0.197
1989	20	3.55	0.000	0.000	0.060	0.060	0.128	0.092	0.052	0.271

[a]Age-0 cutthroat trout not observed after stocking 117,000 hatchery fry

cutthroat trout, but the density of age-II and older cutthroat trout in 1988 was different from densities in 1983, 1984, and 1985. The increased densities of age-I and age-II and older fish could be a result of stocking cutthroat trout fry each year starting in 1984, but further testing with replicate streams would be necessary to verify the cause and effect relation.

Densities of age-I brook trout were significantly higher (α=0.1) in 1988 than densities in all other years but 1986, and densities of age-II and older brook trout were significantly higher (a=0.1) in 1988 than densities for all other years (Figure 3).

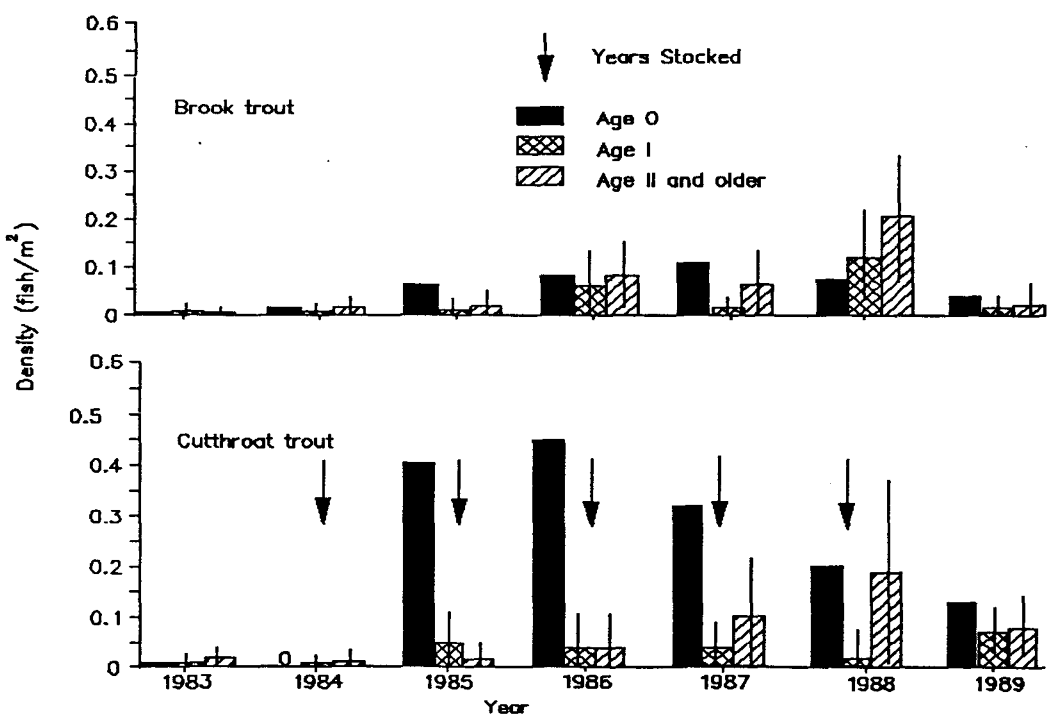


Figure 3. Age-0, -I, and -II, and older cutthroat and brook trout density (fish/m^2) in pools of Blacktail Creek and years when cutthroat trout fry were stocked.

The mean density of fish in Blacktail Creek for 1987, 1988, and 1989 was about 0.33 fish/m^2 (excluding age-O fishes). About 47% of the fish present were age-I and older brook trout, and 53% were age-I and older cutthroat trout. The combined density of age-I and older cutthroat and brook trout was highest in 1988, at 0.56 fish/m^2, made up of about 61% brook trout and 39% cutthroat trout.

In Jost Creek, the tributary of Blacktail Creek with cutthroat trout fry stocked only in 1981 and 1984, there was no trend toward increased numbers of age-I trout of either species ($P > 0.061$), but there was a significant increasing trend for age-II and older cutthroat trout ($P < 0.047$, Table 3). Densities of age-I cutthroat trout were significantly higher (α=0.1) in 1985, the year following stocking, than densities in all other years (Figure 4, Table 3). Age II and older cutthroat trout were more abundant (a=0.1) in 1987 than in 1983, 1984, and 1985. Densities of age-I and -II and older brook trout did not differ significantly (a=0.1) between study years.

Cutthroat trout in streams with brook trout removed

In July of 1986, 568 brook and 2 cutthroat trout were removed from the lower two-thirds of Cache Creek to determine if stocked cutthroat trout would live in a stream formerly occupied by brook trout (Cowley 1987). Most, but not all, of the brook trout were removed by the cyanide treatment. By late August of 1986, Cowley (1987) observed 3 brook trout in

15% of the 20 pools snorkeled. In 1987, 1988, and 1989, 5, 8, and 14 brook trout were observed in 24%, 12%, and 33% of the 21, 18, and 21 pools snorkeled, respectively.

Brook trout were the dominant species in Cache Creek before their removal, with average age-I and age-II and older densities of 0.11 and 0.14 fish/m^2 in the summer of 1986 (Cowley 1987). Following removal of fish, the density of all ages of brook trout was 0.017 fish/m^2 in August of 1986. In subsequent years, the mean density of all brook trout was 0.041, 0.043, and 0.058 fish/m^2 in 1987, 1988 and 1989, respectively.

Cutthroat fry were stocked in Cache Creek in 1986 (58,514 fry) following the removal of fish, and then again in 1987 (99,608) and 1988 (97,000). In 1987, the mean density of age-I cutthroat trout was 0.33 fish/m^2, but dropped to less than 0.1 fish/m^2 in 1988 and 1989 (Figure 5). The densities of age-I and older cutthroat trout in 1988 (0.185 fish/m^2) and 1989 (0.203 fish/m^2) were lower than the densities of brook trout in 1986 before their removal (0.25 fish/m^2).

The abundance of age-II and older cutthroat trout increased significantly during the seven years of study (slope of regression line was different from zero, P = 0.0001, Table 3). The average densities of age-II and older cutthroat trout prior to the removal of the fish were 0.004 (±0.009) and 0.005 (±0.009) fish/m in 1983 and 1984, respectively, compared to

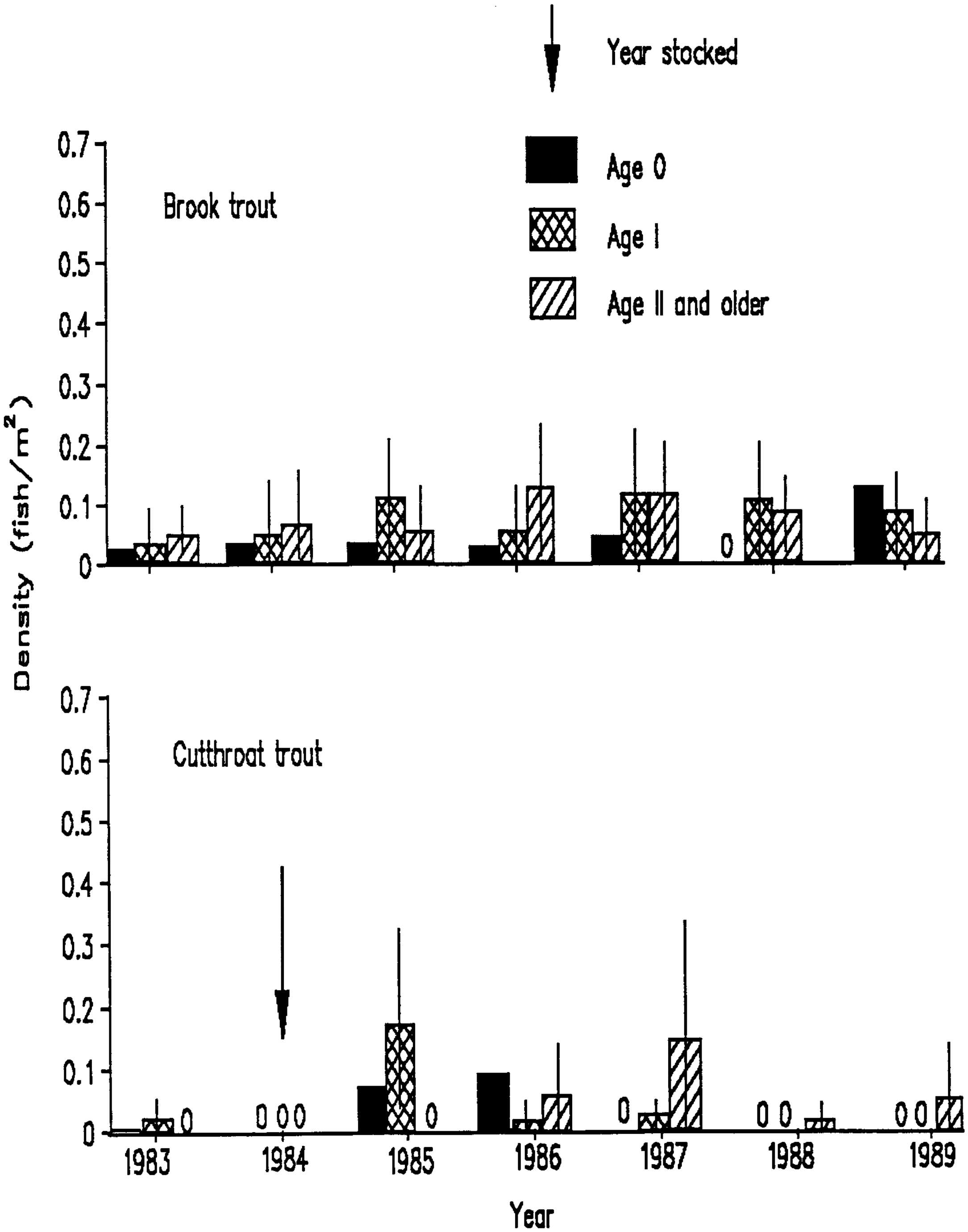


Figure 4. Age-0, -I, and -II and older cutthroat and brook trout density (fish/m^2) in pools of Jost Creek. Jost Creek served as an experimental control for Blacktail Creek (Figure 3).

Table 3. The probability of a regression line slope significantly different (a=0.05) from zero for mean densities of age-0, -I, -II and older, and total cutthroat and brook trout for years studied from 1983 to 1989.

Location	Cutthroat trout				Brook trout			
Creek	0	I	II+	Total	0	I	II+	Total
Granite Cr. Drainage								
Blacktail	0.01	0.01	0.002	0.0004	0.006	0.009	0.001	0.0002
Cache	*	*	0.0001	0.003	-0.001	*	*	*
Jost	*	*	0.047	*	0.02	*	*	0.007
Packer	*	*	0.0007	*	+	+	+	+
Zero	*	*	0.002	*	+	*	*	*
West-side								
Beaver	0.0006	*	*	*	*	0.03	*	*
Granite (Main)	+	*	*	*	+	*	*	*
Kalispell	0.008	*	*	*	*	*	*	*
N.F. Granite	+	*	*	*	*	0.01	*	*
S.F. Granite	*	*	*	*	0.02	*	0.049	0.02
East-side								
Indian	*	*	*	*	*	*	*	*
Lion	*	*	0.002	0.0005	+	+	+	+
Two Mouth	*	0.009	0.018	0.005	*	*	*	*
Upper Drainage								
Hughes Fork	*	*	*	*	+	+	+	
Trapper	-0.0005	*	*	*	+	+	+	+
Upper Priest River	+	+	*	*	+	+	+	+
Miscellaneous								
Caribou	*	*	*	*	*	*	+	*
Soldier	+	*	*	*	*	*	*	*

* Regression line slopes not significantly different from zero

\+ Regression lines not calculated due to few or no fish observed

0.155 (±0.105) and 0.146 (±0.059) fish/^{i} two and three years following the removal of fishes and stocking of cutthroat trout fry in 1986 (Table 4).

The regression line for trend in abundance over time for age-I cutthroat trout was not significantly different ($P = 0.082$) from zero because of variability in abundance and the large number of age-I fish in 1987 and lesser numbers in 1988 and 1989. The abundance of age-I cutthroat trout increased to 0.331 fish/m^2 in 1987, the year following the initial cutthroat trout fry stocking, but declined in subsequent years despite continued stocking of fry (Table 4). The reasons for the reduced abundance of age-I cutthroat trout in subsequent years is unclear, but may be related to predation on fry by larger fish. In 1986, there were virtually no larger fish in the stream to prey on the stocked fry.

Table 4. Mean densities (fish/m^2) of age-0, -I, -II and older cutthroat trout, and total cutthroat and brook trout numbers in Cache Creek in August, mean area of habitat units (m^2), and the number of habitat units snorkeled from 1983 through 1989. Underscored years indicate that cutthroat trout fry were stocked. The stream was poisoned to remove brook trout in 1986.

Year	Number of habitat units	Area of habitat units (m^2)	Cutthroat trout 0	I	II+	Total	Brook trout 0	I	II+	Total
1983	30	13.49	0.000	0.007	0.004	0.011	0.027	0.019	0.031	0.076
1984	8	24.81	0.005	0.000	0.005	0.010	0.092	0.070	0.105	0.268
1986	20	10.95	0.803	0.000	0.000	0.803	0.017	0.000	0.000	0.017
1987	21	10.99	0.453	0.331	0.012	0.796	0.010	0.000	0.031	0.041
1988	17	10.94	0.174	0.030	0.155	0.358	0.000	0.025	0.018	0.043
1989	21	10.36	0.004	0.057	0.146	0.207	0.000	0.033	0.025	0.058

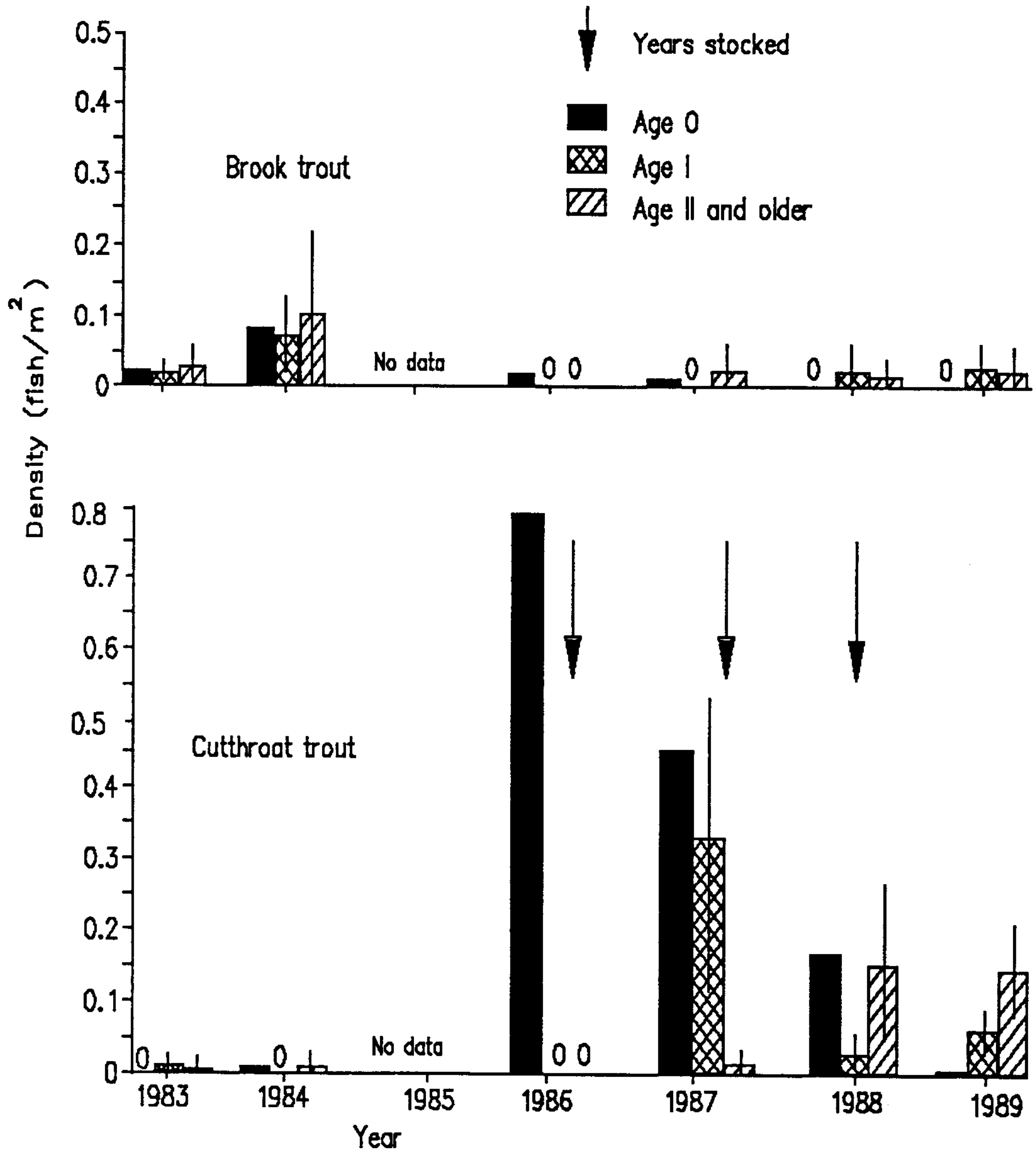


Figure 5. Densities (fish/m^2) of age-0, -I, and -II and older cutthroat and brook trout density in pools of Cache Creek in August of each year of study, and years when cutthroat trout were stocked. All fishes were removed in 1986.

Densities of age-I cutthroat trout were significantly higher ($\alpha = 0.1$) in 1987 compared to all age-I densities in previous years studied. Densities of age-I brook trout were significantly lower (a=0.1) in 1986 after the removal and in 1987 than in 1984, but not different between 1984 and 1988 and 1989. Densities of age-II and older brook trout were significantly higher in 1984 than in 1983, 1986, 1988, and 1989.

The trend in abundance of age-0 brook trout was down, with a negatively sloped regression line of density over time that was significantly different from zero ($P = 0.001$). Age-0 brook trout averaged 0.027 (±0.023) and 0.092 (±0.052) fish/m^2 in 1983 and 1984, respectively, compared to 0.010 (±0.019) fish/m^2 in 1987 and no age-0 fish observed in 1988 and 1989.

Stocking cutthroat trout fry in underseeded streams

Natural fish passage barriers near the mouths of Packer and Zero Creeks prevented brook trout and adfluvial cutthroat trout from colonizing major portions of each creek. These streams were used to determine the densities of cutthroat trout that could be obtained through stocking fry.

Packer Creek -- Packer Creek contained few (no age-I fish in 1984) cutthroat trout upstream from the barrier before it was stocked with fry in 1984. Following the initial introduction of fry, the density of age-I cutthroat trout increased to 0.487 fish/m^2 and remained above 0.030 fish/m^2 through 1989 (Figure 6), but the slope of the density versus time regression line was not significantly different from zero ($P = 0.947$).

The trend in abundance of age-II and older cutthroat trout during the study period was up with a slope for the density versus time regression line that was positive and significant-ly different (α=0.05) from zero.

Cutthroat trout fry were first stocked in Packer Creek in 1984 and densities of age-I cutthroat trout were significantly higher (α=0.1) in 1985 (0.487 fish/m 3 than in all other study years except 1986. As was observed in Cache Creek, the

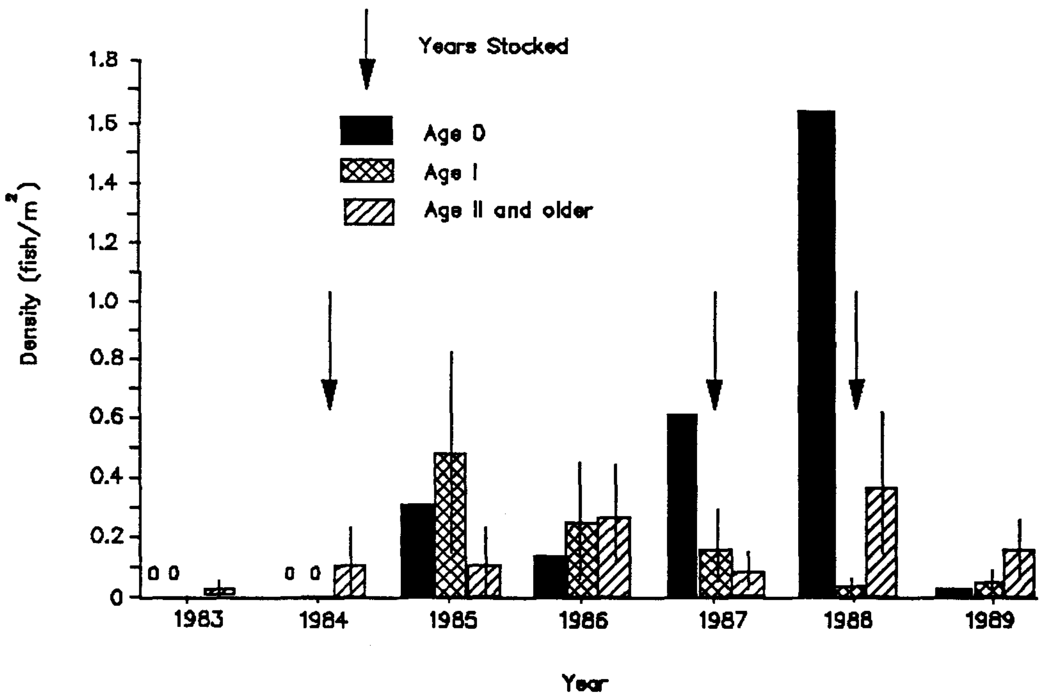


Figure 6. Densities (fish/m^2) of Age-0, -I, -II and older cutthroat trout density in pools of Packer Creek in late summer, and years when cutthroat trout fry were stocked.

abundance of age-I cutthroat trout was highest in the years following the initial stocking of fry, and was significantly lower in subsequent years despite continued stocking. Densities of age-II and older cutthroat trout fluctuated between 0.282 and 0.383 fish/m^2 from 1986 to 1989 (Table 5).

Zero Creek -- No cutthroat trout were observed in Zero Creek before cutthroat trout fry were stocked in 1981 (Mauser and Ellis 1985). In subsequent years, age-0 cutthroat trout were found when stocking occurred, age-I fish were present, but not always in proportion to the number of fry stocked the previous year, and age-II and older fish increased in abundance over time. The slope of the density versus time regression line for age-II and older cutthroat trout was positive and significantly different (P = 0.002) from zero. The trend in abundance of age-I cutthroat trout was not significantly different (P = 0.679) from zero. The density of age-I cutthroat trout was significantly higher (α=0.10) in 1986 (0.282 fish/m^2) than in the other years, and probably resulted from the 6.01 fry/m^2 stocked in 1985 (Figure 7). Densities of age-II and older cutthroat trout in 1988 were significantly higher than in 1983, 1984, 1985, and 1986, but not those in 1987 (Table 5).

Table 5. Mean densities (fish/m^2) of age-0, -I, -II and older cutthroat trout, and total cutthroat and brook trout numbers in Packer and Zero Creeks, mean area of habitat units (m^2), and the number of habitat units snorkeled from 1983 through 1989. Underscored years indicate that cutthroat trout fry were stocked.

Creek Year	Number of habitat units	Area of habitat units (m^2)	Cutthroat trout 0	I	II+	Total	Brook trout 0	1	II+	Total
Packer										
1983	40	12.49	0.000	0.000	0.010	0.010	0.000	0.000	0.000	0.000
1984	7	13.35	0.000	0.000	0.104	0.104	0.000	0.000	0.000	0.000
1985	19	4.92	0.306	0.487	0.104	0.897	0.000	0.000	0.000	0.000
1986	20	5.13	0.147	0.255	0.282	0.684	0.000	0.000	0.000	0.000
1987	25	6.36	0.601	0.167	0.097	0.865	0.000	0.000	0.000	0.000
1988	25	6.09	1.638	0.031	0.383	2.052	0.000	0.000	0.000	0.000
1989	29	5.86	0.009	0.046	0.170	0.225	0.000	0.000	0.000	0.000
Zero										
1983	38	21.40	0.001	0.038	0.127	0.167	0.000	0.000	0.001	0.002
1984	7	30.15	0.003	0.004	0.089	0.096	0.000	0.000	0.007	0.007
1985	20	11.59	0.908	0.004	0.174	1.086	0.000	0.000	0.000	0.000
1986	29	8.34	0.000	0.282	0.039	0.322	0.000	0.000	0.000	0.000
1987	27	8.62	0.231	0.041	0.215	0.487	0.000	0.004	0.004	0.008
1988	25	9.53	0.276	0.008	0.362	0.647	0.000	0.000	0.000	0.000

Cutthroat trout *densities in streams closed to angling*

All creeks considered important for the production of cutthroat trout were closed to angling in 1982 and subsequent years and snorkel transects were established to monitor changes in abundance of juvenile cutthroat trout. Streams were placed in four categories based on location: west-side tributaries (Beaver, Granite, Kalispell, S.F. Granite Creeks), east-side tributaries (Indian, Lion, and Two Mouth Creeks), those in the upper drainage (Hughes Fork Creek, Trapper Creek, Upper Priest River) and miscellaneous creeks (Caribou and Soldier).

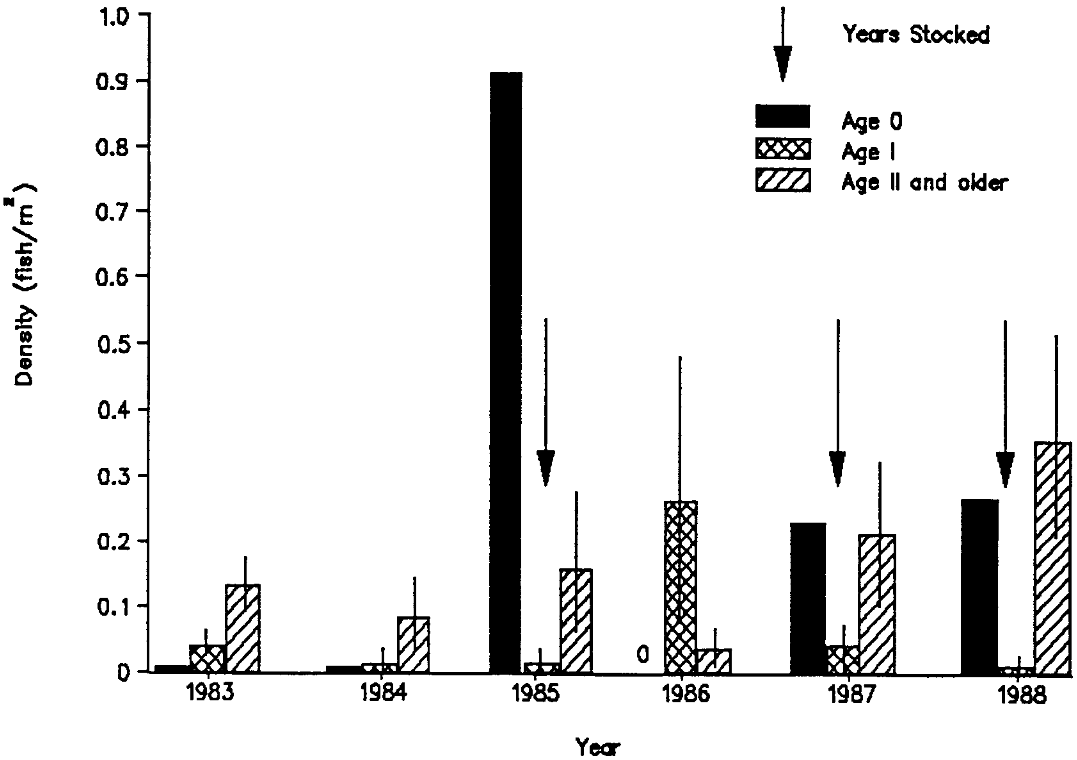


Figure 7. Densities (fish/m^2) of Age-0, -I, -II and older cutthroat trout density in pools of Zero Creek in late summer, and years when cutthroat trout fry were stocked.

The only streams with a significant increasing trend in abundance from 1983 to 1989 were Two Mouth Creek for age I, age II and older, and total cutthroat trout (P s 0.018) and Lion Creek for age-II and older and total cutthroat trout ($P \leq 0.002$) (Figures 8-11). In both of these streams, the regression lines were mostly due to the low densities of fish observed in 1983 versus higher densities in later years.

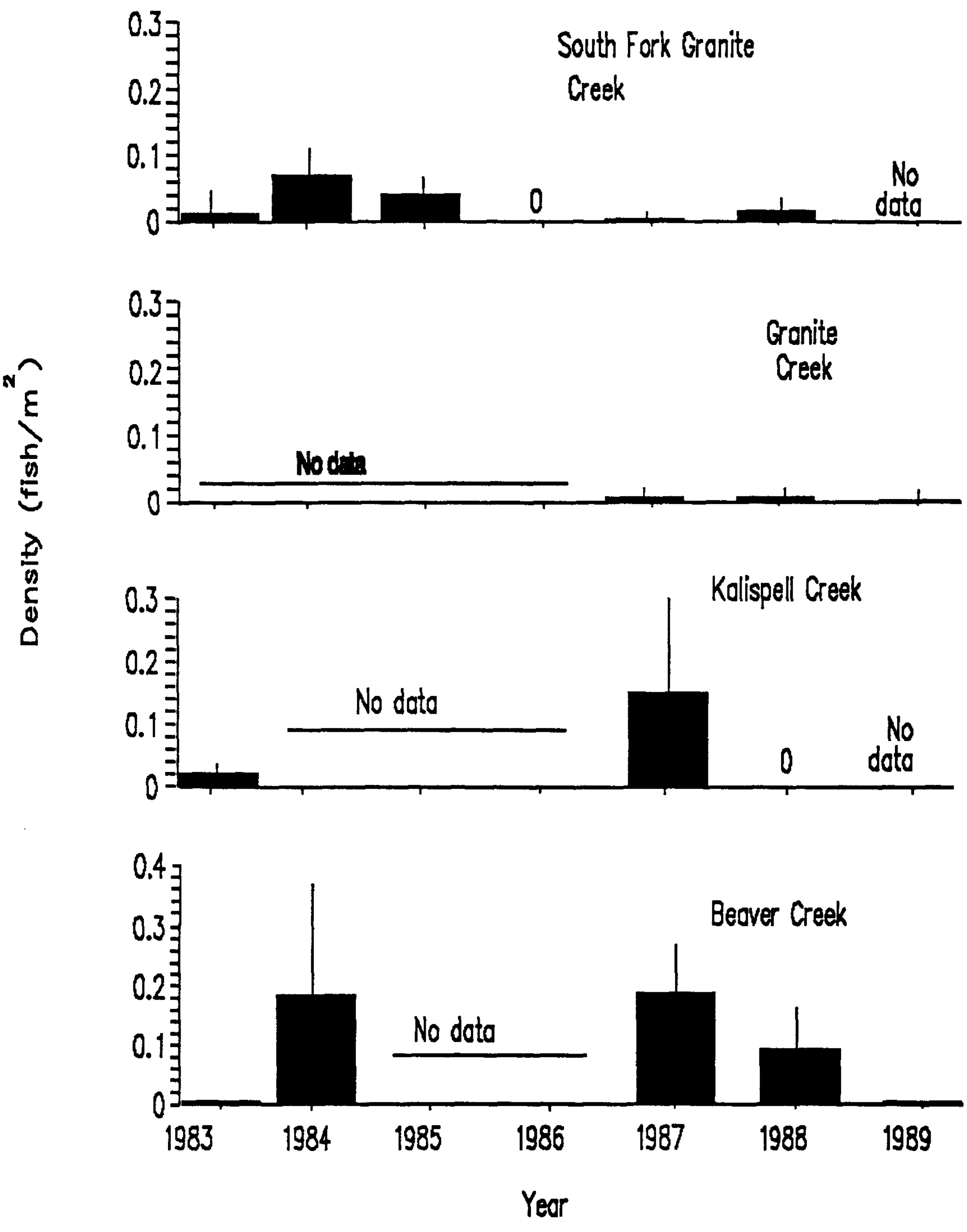


Figure 8. Combined density (fish/m^2) for all ages of cutthroat trout in pools and pocketwaters for selected years between 1983 and 1989 in west-side tributaries.

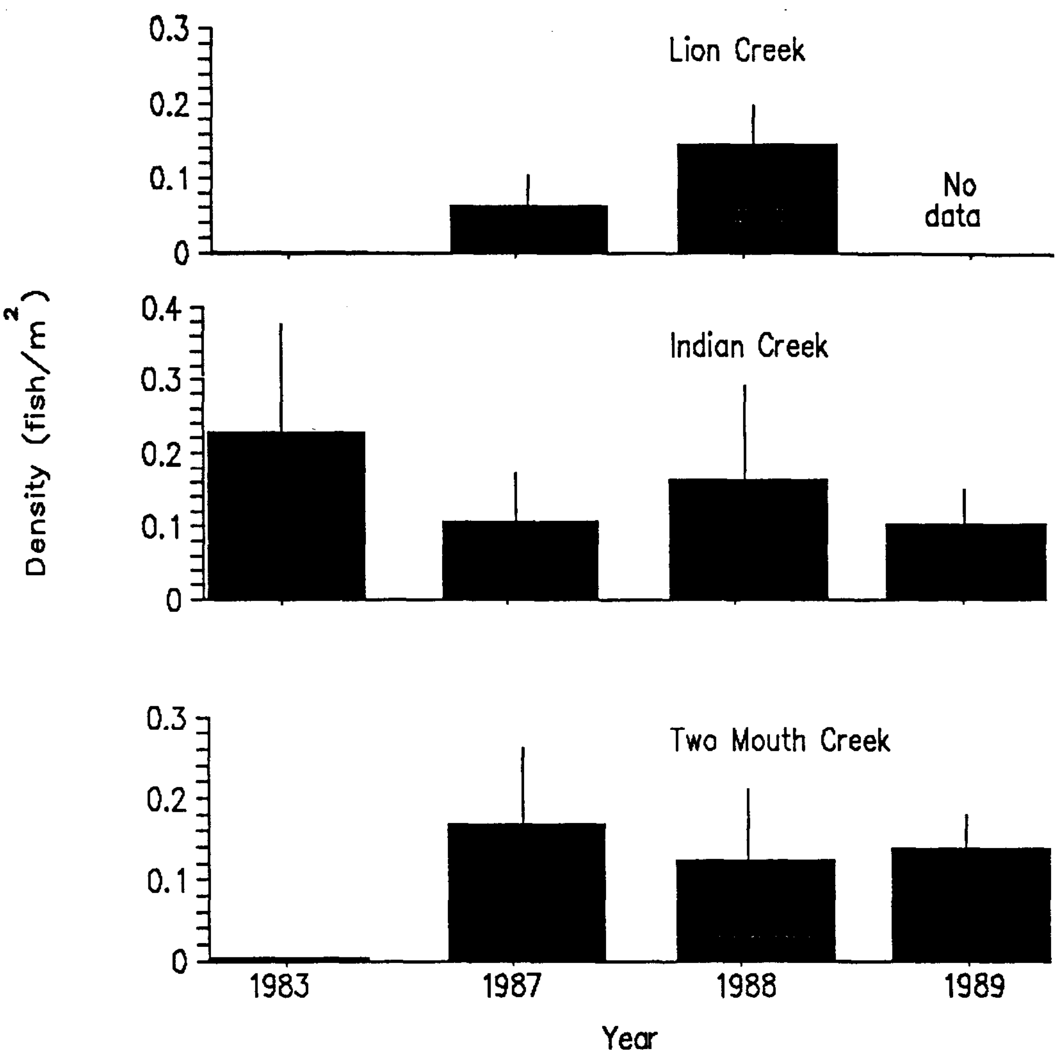


Figure 9. Combined density (fish/m^2) for all ages of cutthroat trout in pools and pocketwaters for selected years between 1983 and 1989 in east-side tributaries.

The density of cutthroat trout varied widely between streams and between years within streams. Densities were less than 0.3 fish/m^2 in all years and streams (Figures 8-11). Indian and Two Mouth Creeks on the east-side of Priest Lake had few brook trout, and no brook trout were seen in Lion Creek in 1987 and 1988. Few brook trout were observed in

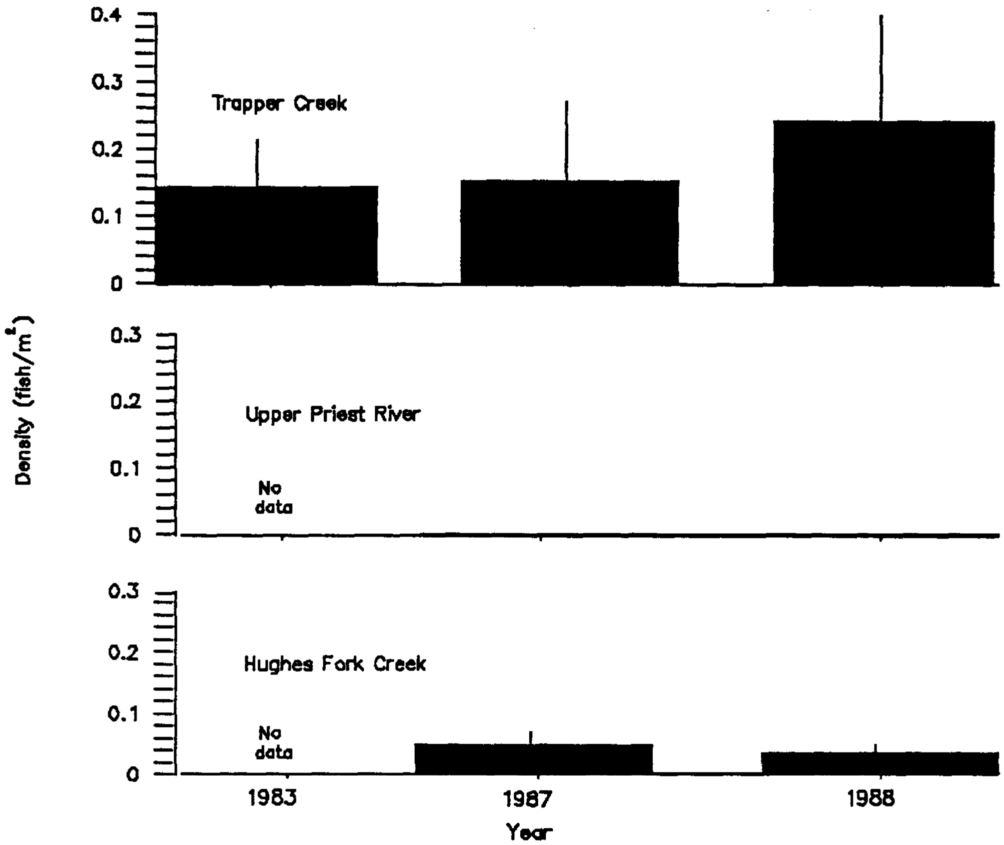


Figure 10. Combined density (fish/m^2) for all ages of cutthroat trout in pools and pocketwaters for selected years between 1983 and 1989 in the Upper Priest Lake tributaries.

tributaries flowing into Upper Priest Lake; 0.009 fish/m^2 in 1988 in Hughes Fork Creek, and no brook trout were observed in either Trapper Creek or the Upper Priest River in 1987 or 1988 (Appendix A). Cutthroat trout in Soldier Creek were concentrated near the headwaters, with brook trout in the lower reaches of the stream. Cutthroat trout densities remained low in Caribou Creek in 1987 and 1988 (Figure 11).

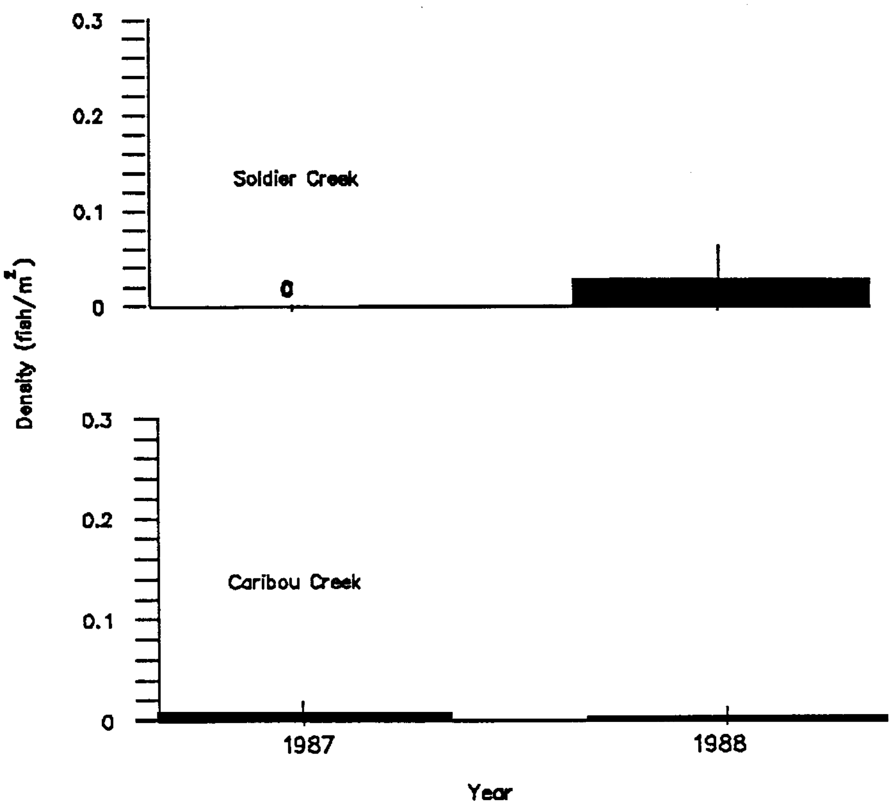


Figure 11. Combined density (fish/m^2) for all ages of cutthroat trout in pools and pocketwaters for 1987 and 1988 for Caribou and Soldier Creeks. Caribou Creek was closed to angling in 1982 while soldier Creek remained open.

Discussion

Stocking cutthroat trout fry was an effective way to increase abundance of fry and older fish in streams underseeded with cutthroat trout. Few ($0.01/m^2$) age-II and older fish, and no age-0 or -I fish were seen in Packer Creek during 1983, but densities of age-I cutthroat trout were significantly higher in 1985 ($a=0.1$) following stocking in 1984. Densities of age-II and older cutthroat trout increased significantly ($a= 0.1$) from 1983 to 1986.

The highest fish densities were found in 1988. The reduced fish densities of all ages observed in 1989 is unexpained.

A more useful tool in assessing changes in fish abundance than comparing densities from year to year is to observe trends over several years. During the seven years of study, there was an increasing trend in the densities of age-II and older cutthroat trout ($P = 0.0007$) in Packer Creek. The trend in densities of age-I fish was not signif-icant ($P = 0.947$) during the full study period (1983 to 1989), but there was an increasing trend from 1983 to 1987.

Zero Creek was also underseeded with cutthroat trout in 1983 and the abundance of cutthroat trout was increased by stocking fry. Prior to the stocking of fry in 1981, fish were not observed in Zero Creek while electro-fishing (Mauser and Ellis 1985). By 1983, a few age-0 ($0.001/m^2$) and age-I ($0.0381/m^2$) fish were present. Age-0 cutthroat trout increased each year following the release of hatchery fry in

1985, 1987, and 1988, but the upward trend was not significant ($P = 0.368$) during the study period. The density of age-II and older fish in 1983 was 0.127 fish/m^2, probably a result of the fry stocked in 1981. Only age-II and older cutthroat trout had an increasing trend ($P = 0.002$) over the seven year period with the highest densities in 1987 (0.21) and 1988 (0.36).

Removing brook trout and stocking cutthroat trout fry in Cache Creek was an effective way to increase cutthroat trout abundance. In 1983 and 1984, prior to the removal of fish and stocking of fry, densities of all ages of cutthroat trout were low (0.011 fish/m^2 and 0.010 fish/m^2, respectively). Following the removal of brook trout and stocking of cutthroat trout fry, densities of all cutthroat trout combined were above 0.206 fish/m^2 for each year studied. The most noticeable increase in abundance of cutthroat trout occurred in 1987, one year after the removal of brook trout and introduction of hatchery fry into Cache Creek. Age-II and older and total cutthroat trout had an increasing trend ($P < 0.003$) during the study period. Total brook trout abundance decreased significantly (α=0.1) as a result of chemical treatment from 0.268 fish/m^2 in 1984 to 0.043 and 0.058 fish/m^2 in 1988 and 1989, respectively. From these data, I conclude that streams with few or no fish present would provide the greatest opportunity to increase the abundance of cutthroat trout.

Stocking cutthroat trout fry was only a marginally effective way of increasing cutthroat trout abundance in Blacktail Creek where brook trout were present. Densities of age-II and older cutthroat trout were higher (α=0.10) in 1988 than in 1983, 1984 or 1985, but densities of age-I cutthroat trout, the age class most likely to provide migrants to the lake, did not change significantly between years during the study, despite the stocking of large numbers of fry. Each age class of cutthroat and brook trout had an increasing trend (P 5 0.01) of abundance, but low densities of cutthroat and brook trout in 1983 and moderate increases in later years were likely responsible for the trend.

Densities of age-0, -I, and -II and older brook trout in Jost Creek, the control stream, changed little during the study with an age-II and older density of 0.050 fish/m^2 in 1983 and 0.052 fish/m^2 in 1989. Densities of cutthroat trout also changed little during the study period except one year following the introduction of fry in 1984 when densities of age-I cutthroat trout increased from zero fish to 0.178 fish/m^2 in 1985. However, without subsequent fry stocking, the density of age I cutthroat trout dropped to 0.026 fish/m^2 in 1987, and in 1988 and 1989 no age-I fish were observed. Densities of cutthroat trout were higher in stocked creeks without brook trout present than in those with brook trout. After the stocking of hatchery fry, densities of age-0 cutthroat trout increased in Packer, Zero, Cache, and Blacktail Creeks, but densities of age-I and -II and older cutthroat trout changed little one and two years after stocking fry in Blacktail Creek. Jost Creek, stocked only in 1984, had the lowest cutthroat trout densities compared to other stocked creeks, and Blacktail Creek, stocked for five consecutive years, had densities of cutthroat trout that were lower than those in stocked streams without brook trout present (Packer, Zero, and Cache Creeks). I believe stocking of cutthroat trout fry in streams that contain brook trout will be of little or no benefit, and will not result in the displacement of brook trout by cutthroat trout.

Mean densities of age-I and older cutthroat and brook trout combined were similar in all the stocked creeks in the Granite Creek drainage at about 0.3 fish/m^2 (Table 6). Streams with large numbers of brook trout had small numbers of cutthroat trout and visa versa (Figure 12).

Densities were more variable when age-0 cutthroat trout were included in the analysis of combined densities. Variability in abundance of age-0 fish could have resulted from the number stocked, from predation by older brook and cutthroat trout (Cummings 1986, Griffith 1972, Miller 1958), genetic composition (Barns 1967, Miller 1958), and limiting stream resources (Chapman 1966, Bjornn 1961, Griffith 1974). Handling of fry during transport might also have increased the variability, as in 1987 when fry suffered from reduced oxygen levels. The highest maximum densities for all species and ages of fish combined were observed in Packer Creek at 1.047

Table 6. Mean densities (fish/m^2) of age-0, -I, -II and older cutthroat and brook trout for years with the highest abundance of fish in stocked creeks, and mean densities of all fish and age-I and older fish of both species combined.

Creek Year Mean	Cutthroat trout (fish/m^2)			Brook trout (fish/m^2)			All trout	Age-I and older trout
	0	I	II+	0	I	II+		
Blacktail								
1987	0.334	0.045	0.102	0.120	0.018	0.066		
1988	0.202	0.023	0.193	0.086	0.134	0.206		
1989	0.144	0.077	0.085	0.047	0.014	0.022		
Mean	0.227	0.048	0.127	0.084	0.055	0.098	0.639	0.328
Cache								
1987	0.453	0.331	0.012	0.010	0.000	0.031		
1988	0.174	0.030	0.155	0.000	0.025	0.018		
1989	0.004	0.057	0.146	0.000	0.033	0.025		
Mean	0.210	0.139	0.104	0.003	0.019	0.025	0.501	0.288
Jost								
1986	0.097	0.016	0.066	0.027	0.062	0.130		
1987	0.000	0.026	0.153	0.041	0.118	0.113		
1988	0.000	0.000	0.015	0.000	0.107	0.090		
1989	0.000	0.000	0.060	0.128	0.092	0.050		
Mean	0.000	0.009	0.076	0.056	0.106	0.084	0.331	0.275
Packer								
1986	0.147	0.255	0.282	0.000	0.000	0.000		
1987	0.601	0.167	0.097	0.000	0.000	0.000		
1988	1.638	0.031	0.383	0.000	0.000	0.000		
1989	0.009	0.046	0.170	0.000	0.000	0.000		
Mean	0.749	0.081	0.217	0.000	0.000	0.000	1.047	0.298
Zero								
1986	0.000	0.282	0.039	0.000	0.000	0.000		
1987	0.231	0.041	0.215	0.000	0.004	0.004		
1988	0.276	0.008	0.362	0.000	0.000	0.000		
Mean	0.169	0.110	0.205	0.000	0.001	0.001	0.487	0.318

fish/m^2, the lowest maximum was in Jost Creek at 0.331 fish/m^2. The mean maximum density for all five creeks was 0.601 fish/m^2 (Figure 13).

The mean biomass density (g/m^2) of cutthroat and brook trout for each of the five creeks was similar, whether for age-I and older fish (Figure 14) or for all ages of cutthroat and brook trout (Figure 15). Biomass densities were less variable than numbers density between creeks because the mean weights of fry (0.15 grams) were small and large differences in numbers of fry did not change the biomass as much as a change in the number of older fish (4.08 grams for age-I fish and 27.31 grams for age-II and older fish, Piper 1982). The average maximum biomass for all fish combined was about 5.84 g/m^2 for the five creeks, with a range from 7.05 g/m^2 in Blacktail Creek to 4.32 g/m^2 in Cache Creek (Table 7).

Densities of cutthroat trout for representative creeks from five northern Idaho drainages were compared to evaluate the densities observed in large and small creeks of the Priest Lake drainage. Densities (fish/m^2) of (ages-I and older) cutthroat trout were higher in small creeks (less than 5 meters wide) than in large creeks (greater than 5 meters wide). Densities of cutthroat trout in small creeks ranged from 0.108 to 0.625 fish/m^2 with a mean of 0.25 fish/m^2 (Table 8). In larger creeks the density of cutthroat trout ranged from 0.057 to 0.407 fish/m^2 with a mean of 0.17 fish/m^2. Streams with mostly cutthroat trout often had densities that were less than the maximum densities observed and had densities that, I believe, were less than the carrying capacity. The maximum densities observed in the infertile

Table 7. Mean and total biomass (grams/m^2) of age -0, -I, II and older cutthroat and brook trout for years with the highest abundance of fish in stocked creeks.

Creek Year Mean	Cutthroat trout (grams/m^2) 0	I	II+	Brook trout (grams/m^2) 0	I	II+	All trout	Age-I older trout
Blacktail								
1987	0.050	0.182	2.783	0.022	0.087	2.069		
1988	0.031	0.096	5.258	0.016	0.630	6.482		
1989	0.022	0.313	2.334	0.009	0.066	0.705		
Mean	0.034	0.197	3.458	0.015	0.261	3.085	7.051	7.002
Cache								
1987	0.068	1.349	0.317	0.002	0.000	0.984		
1988	0.026	0.123	4.223	0.000	0.117	0.574		
1989	0.001	0.233	3.990	0.000	0.155	0.788		
Mean	0.032	0.569	2.843	0.001	0.091	0.782	4.317	4.284
Jost								
1986	0.015	0.063	1.797	0.005	0.292	4.090		
1987	0.000	0.107	4.184	0.007	0.559	3.549		
1988	0.000	0.000	0.403	0.000	0.505	2.829		
1989	0.000	0.000	1.634	0.023	0.434	1.628		
Mean	0.000	0.036	2.074	0.010	0.499	2.669	5.288	5.278
Packer								
1986	0.022	1.040	7.700	0.000	0.000	0.000		
1987	0.091	0.682	2.653	0.000	0.000	0.000		
1988	0.247	0.125	10.473	0.000	0.000	0.000		
1989	0.001	0.188	4.632	0.000	0.000	0.000		
Mean	0.113	0.331	5.919	0.000	0.000	0.000	6.364	6.251
Zero								
1986	0.000	1.219	1.127	0.000	0.000	0.000		
1987	0.035	0.168	5.864	0.000	0.018	0.121		
1988	0.042	0.034	9.889	0.000	0.000	0.000		
Mean	0.026	0.474	5.627	0.000	0.006	0.040	6.173	6.147

nursery streams of Priest Lake (0.1 to 0.3 fish/m^2 and 4.0 to 7.0 g /m^2) were approximations of the full-seeding density or carrying capacity for age-0 and older trout.

Table 8. Densities of age-I and older cutthroat trout (fish/m^2) in large and small creeks believed to be nursery streams for cutthroat trout in northern Idaho drainages from 1971 through 1989.

Drainage Creeks Year	Mean cutthroat trout density (fish/m^2)	Mean density by creek	Mean Width(m)	Source of Data
Creeks less than 5 meters wide				
Priest Lake				
Cache				
1987	0.343		3.07	This Study
1988	0.185		3.07	
1989	0.203	0.244	3.07	
Packer				
1987	0.264		2.21	
1988	0.414		2.21	
1989	0.216	0.298	2.21	
Pend Oreille Lake				
Grouse section 3				
1986	0.108	0.108	4.0	**Hoelscher(1989)**
Coeur d'Alene				
Wolf lodge				
Clear cut				
1975	0.130		1.5	Lukens (1978)
1976	0.100	0.115	1.5	Lukens (1978)
Lonesome				
1975	0.000		2.5	Lukens (1978)
1976	0.750	0.387	2.5	Lukens (1978)
Stella				
1975	0.390		*	Lukens (1978)
1976	0.960	0.675	*	Lukens (1978)
N.F. Clearwater				
Beaver Dam	2			
1983	0.167	0.167	*	Moffitt and Bjornn (1984)
Middle section 3				
1983	0.125	0.125	*	Moffitt and Bjornn (1984)

Table 8 (continued)

Drainage Creeks Year	Mean cutthroat trout density (fish/m^2)	Mean density by creek	Mean Width(m)	Source of Data
Rock				
1989	0.338	0.338	3.8	Unpublished data ICFWRU
Lightning				
1989	0.326	0.326	3.4	Unpublished data ICFWRU
N.F. Clearwater (continued)				
Bear				
1989	0.155	0.155	4.8	Unpublished data ICFWRU
Rapid				
1989	0.194	0.194	3.29	Unpublished data ICFWRU
Creeks greater than 5 meters wide				
Priest Lake				
Indian				
1987	0.091		5.0	This Study
1988	0.156		5.0	
1989	0.090	0.112	5.0	"
Two Mouth				
1987	0.143		6.6	
1988	0.123		6.6	"
1989	0.110	0.125	6.6	"
St. Joe River				
Beaver				
1971	0.151		5.5	Mauser (1972)
1972	0.240	0.195	5.5	Athern (1973)
N.F. Clearwater				
Deer				
1989	0.257	0.257	5.9	Unpublished data ICFWRU
Elizabeth				
1989	0.407	0.407	5.8	Unpublished data ICFWRU

Table 8 (continued)

Drainage Creeks Year	Mean cutthroat trout density (fish/m^2)	Mean density by creek	Mean Width(m)	Source of Data
Coeur d'Alene Lake				
Wolf Lodge				
1975	0.130		10	Lukens (1978)
1976	0.100	0.115	10	Lukens (1978)
Pend Oreille				
N.F. Grouse section 2				
1986	0.057	0.057	4.0	Hoelscher (1989)
Trestle section 3 1986	0.100	0.100	4.1	Hoelscher (1989)

* Data on stream width not available

The closure of tributaries to fishing did not result in noticeable increases in abundance of cutthroat trout in eleven of the thirteen tributaries examined. Increased trends in abundance ($P < 0.018$) of age-I and -II and older cutthroat trout were observed in Two Mouth Creek, and of age-II and older cutthroat trout in Lion Creek, but these trends may have been a consequence of low densities of fish in 1983; the trend after 1984 was not significantly different from zero. Densities of cutthroat trout in Two Mouth and Lion Creeks in 1984 and subsequent years were low compared to densities in the stocked creeks despite the angling closure. In Two Mouth Creek, densities of age-I and -II and older cutthroat trout in 1988 were 0.005 and 0.118 fish/m^2 and in 1989 were 0.02 and 0.09 fish/m^2. Densities of age-II and older cutthroat trout

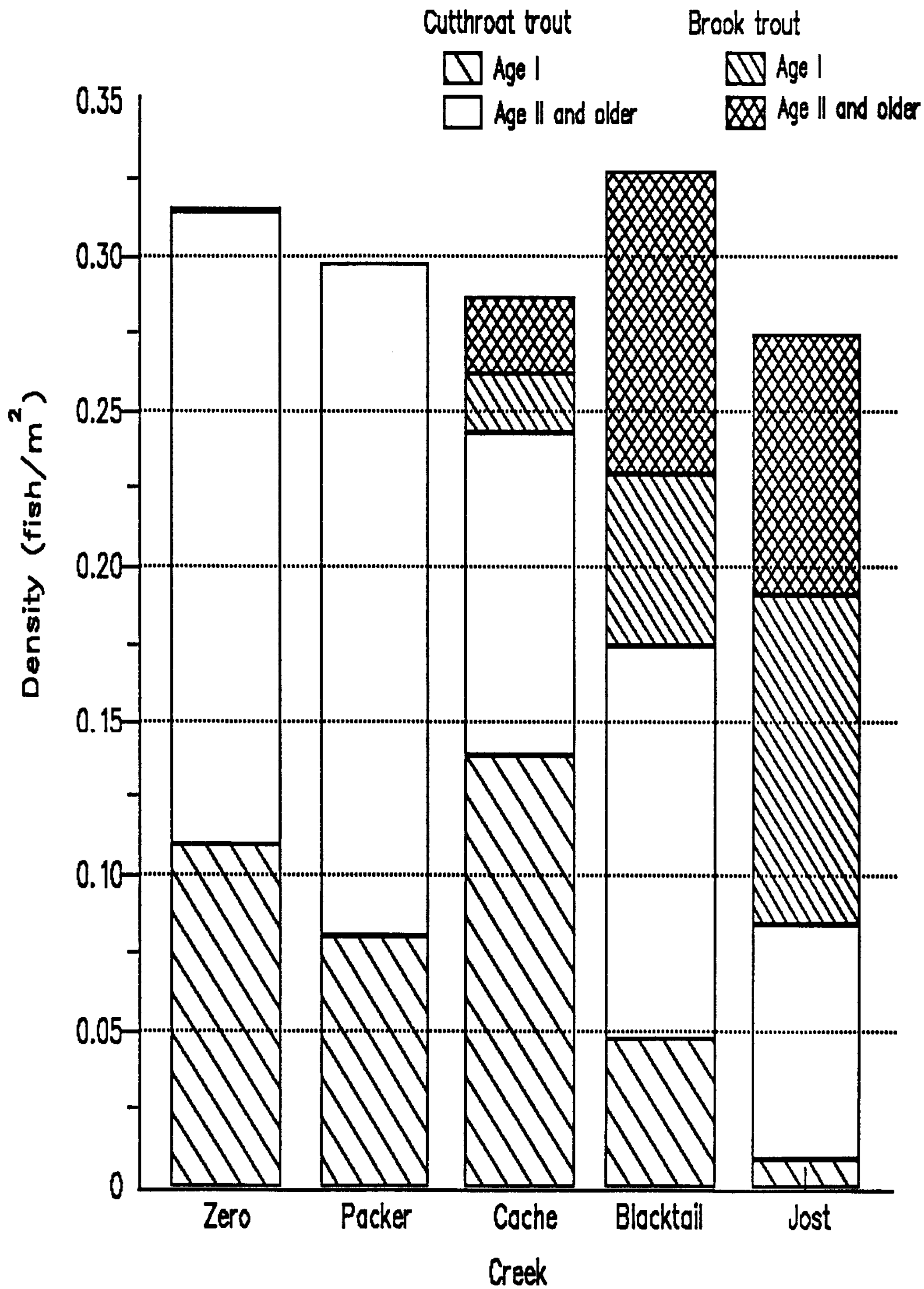


Figure 12. Maximum mean densities (fish/m^2) of age-I and older cutthroat and brook trouts in five small tributaries(<5 m wide) of Granite Creek for years 1986 to 1989.

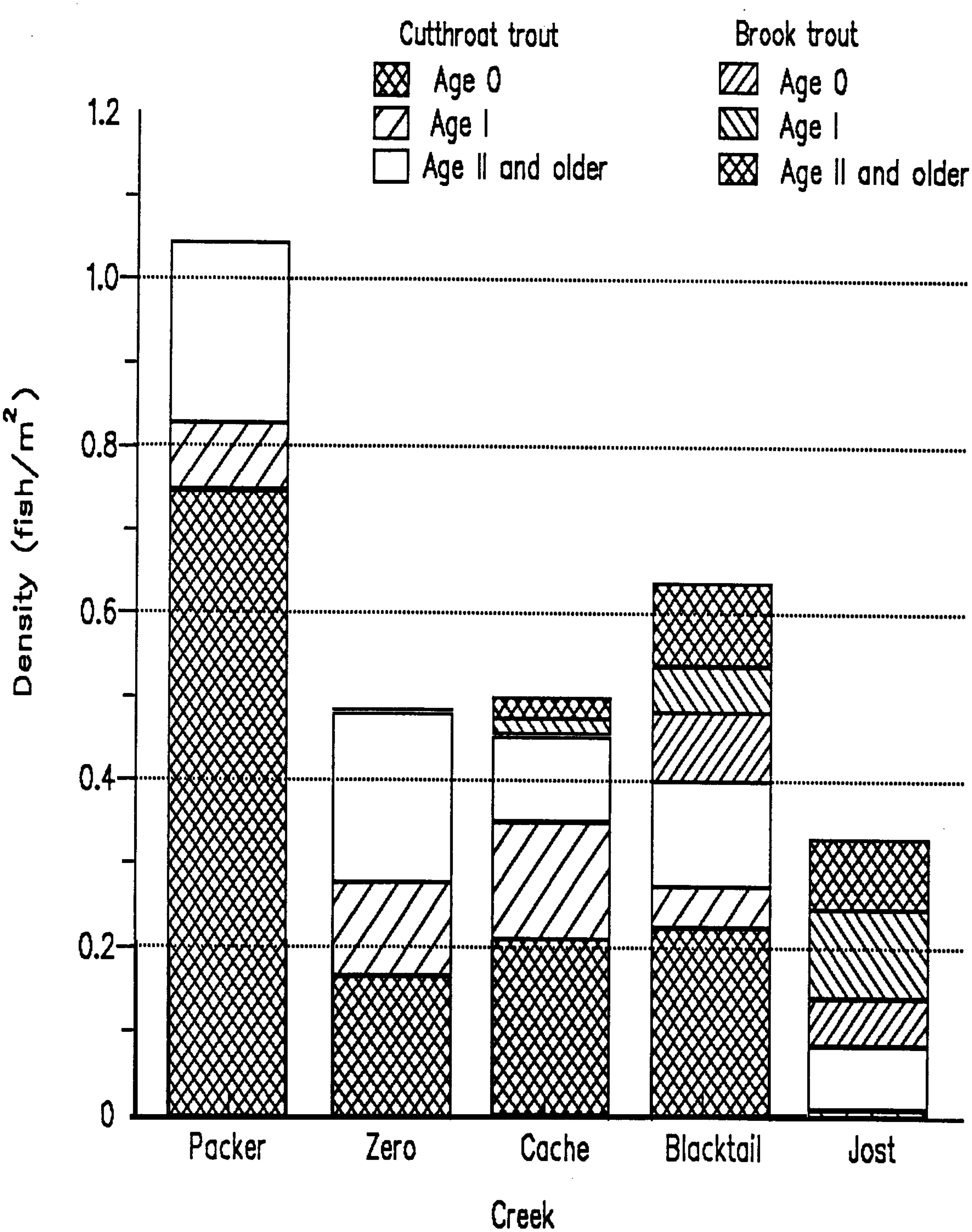


Figure 13. Maximum mean densities (fish/m^2) of all age classes of cutthroat and brook trouts in five small tributaries (<5 m wide) of Granite Creek for years 1986 to 1989.

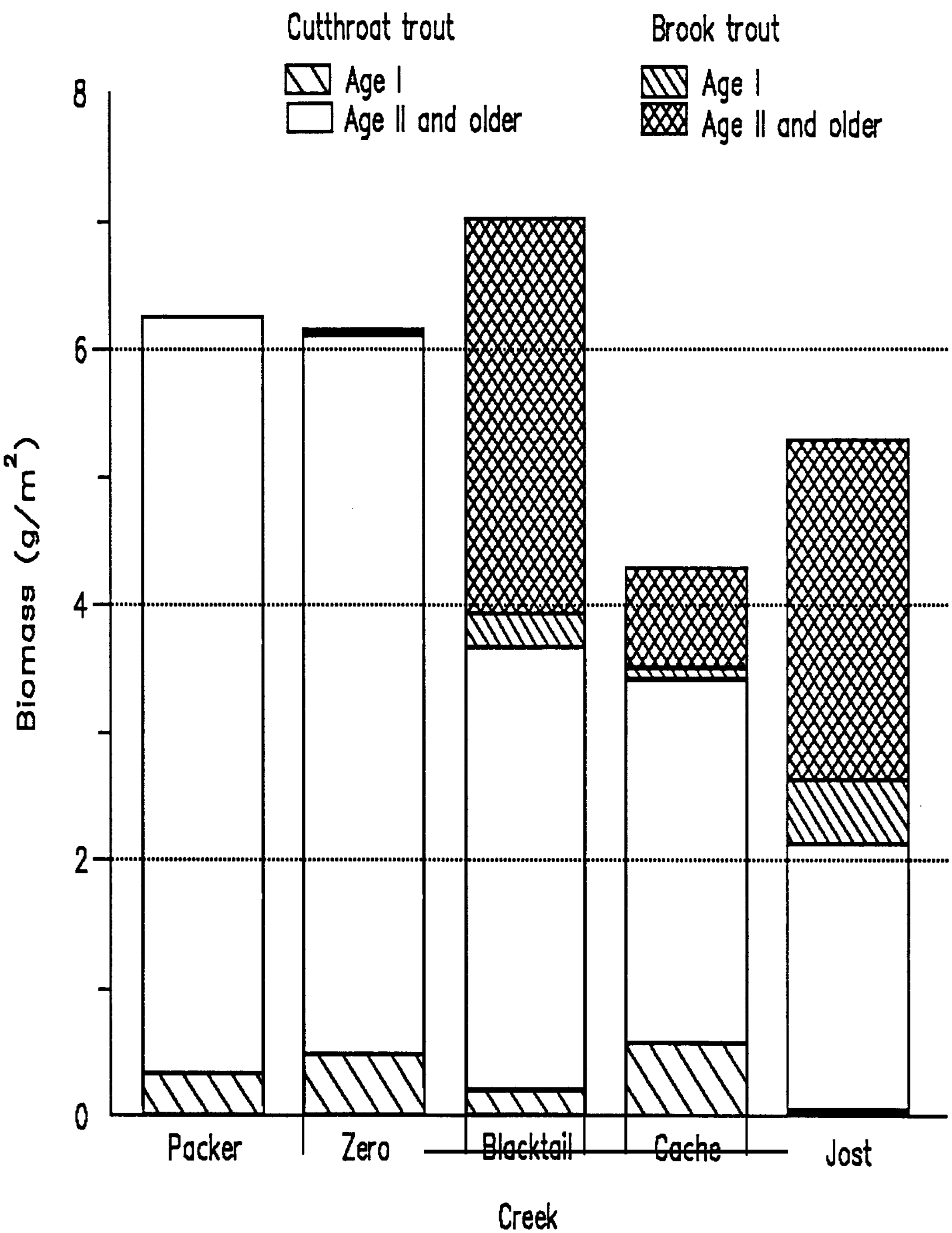


Figure 14. Mean biomass density (grams/m^2) of age-I and older cutthroat and brook trouts in five small tributaries (< 5 m wide) of Granite Creek for years 1986 to 1989.

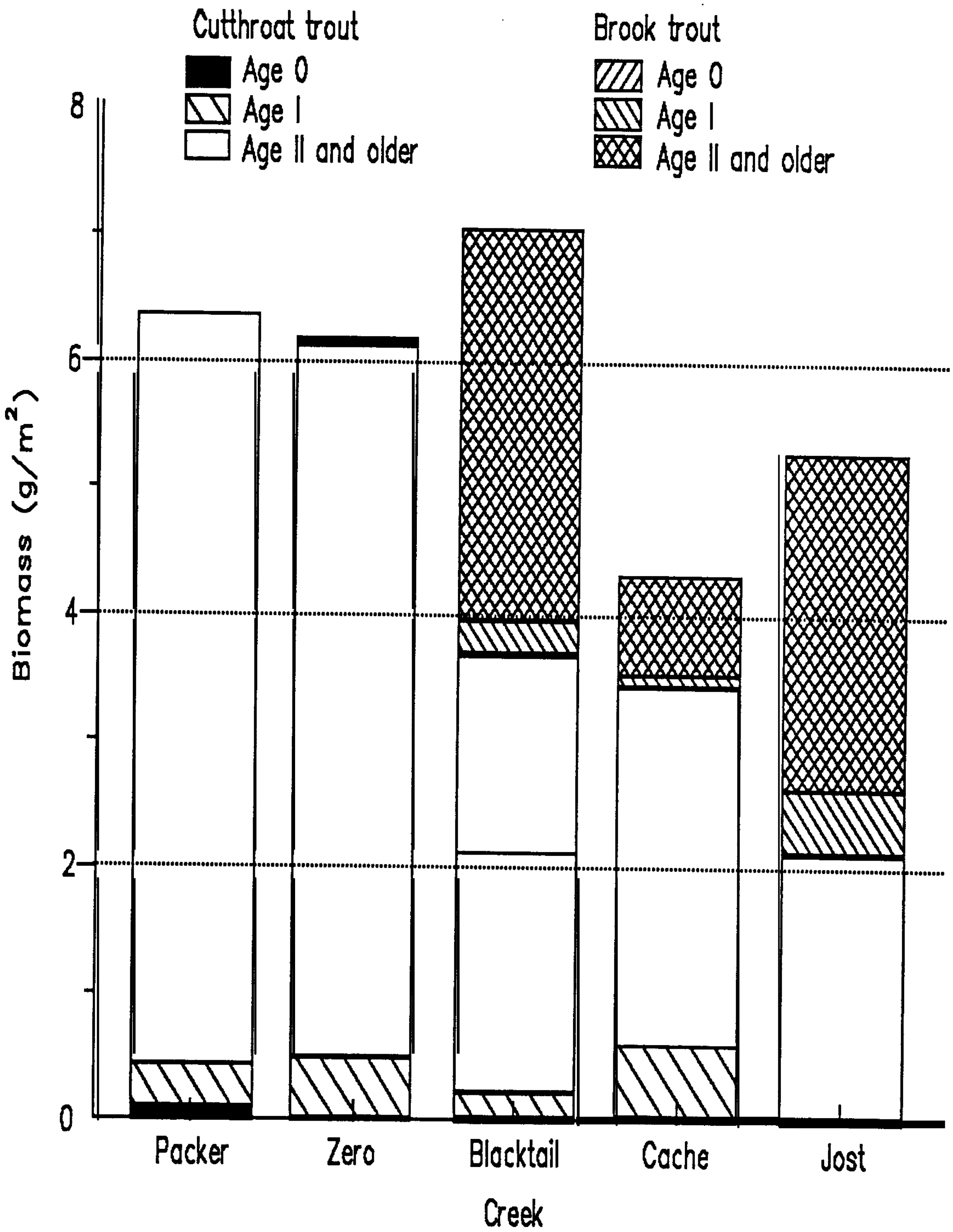


Figure 15. Mean biomass density (grams/m^2) for all age classes of cutthroat and brook trouts for five small tributaries (< 5 m wide) of Granite Creek in years between 1986 and 1989.

in 1987 and 1988 in Lion Creek were 0.059 and 0.124 fish/m^2, respectively. The east-side tributaries, which include Lion and Two Mouth Creeks, probably had a greater potential for increased abundance of cutthroat trout than tributaries on the west-side (Irizarry 1972) of Priest Lake because there were fewer brook trout, higher stream gradients, and a generally higher quality of habitat. Despite the high quality habitat and a closure to fishing, the abundance of cutthroat trout remained low during the period of study.

If managers desire a rapid recovery of cutthroat trout populations, a program aimed at removing brook trout and stocking cutthroat trout fry, similar to the treatment in Cache Creek, would be most effective. Stocking cutthroat trout fry in underseeded streams like Packer and Zero Creeks is an effective means of increasing densities of stream dwelling trout up to the carrying capacity. Stocking fry in creeks with brook trout, however, was only marginally successful. The abundance of age-I cutthroat trout did not change between years in Blacktail Creek, despite five consecutive years of hatchery supplementation. An increase in densities of age-II and older cutthroat trout (some age-III and-IV) did occur with the long-term hatchery supplementation in Blacktail Creek.

When considering alternative ways to increase the abundance of cutthroat trout in the Priest Lake drainage, managers must also consider strategies aimed at controlling lake trout predation on cutthroat trout. The abundance of lake trout has increased in Priest Lake since the introduction of mysis shrimp in August 1966. Recovery efforts for adfluvial cutthroat trout will probably be thwarted by predation in the lake with the current abundance of lake trout. Lake trout prey on cutthroat trout (Mauser 1986) and that form of mortality probably limits the abundance of cutthroat trout (Marnell 1988). In a literature review comparing cutthroat trout recovery efforts in small high mountain lakes to efforts in large northern Idaho lakes, Rieman and Apperson (1989) reported that predators in the large northern Idaho lakes may be an important source of predation on cutthroat trout. Unless the abundance of lake trout is reduced, the stocking of cutthroat trout fry will be of little benefit in increasing the abundance of adfluvial cutthroat trout in Priest Lake. I did not find any evidence that fry stocking resulted in increased production of adfluvial adult cutthroat trout.

The abundance of cutthroat trout in the tributaries would probably decline if the streams were opened to fishing and harvest. Small remnant groups of cutthroat trout would probably persist in inacessible headwater sections of streams, but the adfluvial stocks of fish could be further reduced in abundance. Opening the streams to angling would also increase the chances of adult bull trout being harvested while migrating to spawning areas.

I do not believe additional study of cutthroat trout in the tributaries is necessary, but information on changes in the abundance of cutthroat trout could be obtained by making counts in the transects established in 1987.

Recommendations

A. If the decision is made to enhance cutthroat trout:

1. Reduce abundance of lake trout in Priest Lake
2. Stock cutthroat trout in tributaries
3. Remove brook trout from tributaries before stocking
4. Continue monitoring of abundance of cutthroat trout in lakes and tributaries

B. If the decision is made to maintain viability of cutthroat trout:

1. Stock cutthroat trout fry periodically in tributaries without brook trout present
2. Keep selected tributaries closed to angling

C. If the decision is made to "write-off" cutthroat trout:

1. Discontinue studies of cutthroat trout in tributaries
2. Stop stocking fry in tributaries to increase the abundance of adfluvial adults
3. Open the tributaries to fishing and stock with hatchery trout to provide a put-and-take fishery.

Literature Cited

Barns, R.A., 1967. Differences in performance of naturally and artificially propagated sockeye salmon migrant fry, as measured with swimming and predation tests. Journal of the Research Board of Canada Volume 24, Number 5,

Bjornn, T.C. 1961. Harvest, age structure, and growth of game fish populations from Priest and Upper Priest Lakes. Transactions of the American Fisheries Society 90:27-31.

Bjornn, T.C. and J. Mallet 1964. Movements of wild and planted trout in an Idaho river system. Transactions of the American Fisheries Society 93:70-76.

Chapman, D.W. 1966. Food and space as regulators of salmonid populations in streams. The American Naturalist 100:345-357

Cowley, P.C. 1987. Potential for increasing abundance of cutthroat in streams by stocking fry and removal of brook trout. Master's Thesis. University of Idaho, Moscow.

Cummings, T.R., 1986. Effects of brook trout competition on the threatened Greenback cutthroat trout in Hidden Valley Creek, Colorado. Master's Thesis. Colorado State University, Fort Collins.

Griffith, J.S. 1972. Comparative behavior and habitat utilization of brook trout *Salvelinus fontinalis* and cutthroat trout *Salmo clarki* in small streams in northern Idaho. Journal of Fisheries Research Board of Canada 29:265-273

Griffith, J.S. 1974. Utilization of invertebrate drift by brook trout *Salvelinus fontinalis* and cutthroat trout *Salmo clarki* in small streams in Idaho. Transactions of the American Fisheries Society 103:440-447

Hoelscher, B. 1989. Habitat densities and potential production of trout and char in Pend Oreille Lake tributaries. Job Completion Report, Project F-71-R-10, Subproject III, Job No. 8, Idaho Department of Fish and Game, Boise.

Irizarry, R.A. 1972. Survival and growth of resident and stocked cutthroat trout in Priest and Upper Priest Lakes. Completion Report F-59-R-5. Idaho Department of Fish and Game, Boise.

Irving, D.B. 1987. Cutthroat trout abundance, potential yield, and interaction with brook trout in Priest Lake tributaries. Master's Thesis. University of Idaho, Moscow.

Lewynsky, V.A. 1986. Evaluation of special angling regulations in the Coeur d' Alene River trout fishery. Master's Thesis, University of Idaho, Moscow.

Lukens, J.R. 1978. Abundance, movements and age structure of adfluvial westslope cutthroat trout in the Wolf Lodge Creek drainage, Idaho. Master's Thesis. University of Idaho, Moscow.

Marnell, L.F., 1988. Status of westslope cutthroat trout in Glacier National Park, Montana. American Fisheries Society Symposium 4:61-70

Mauser, G.R., and V. Ellis 1985. Enhancement of trout in large north Idaho lakes. Job Performance Report F-73-R-6, Study III, Job 2. Idaho Department of Fish and Game, Boise.

Mauser, G.R. 1986. Enhancement of trout in large in large north Idaho Lakes. Job Completion Performance Report, Project F-73-R-7, Subproject III, Study III, Job II, Idaho Department of Fish and Game, Boise.

Miller, R.B. 1958. Movements of cutthroat trout after different periods of retention upstream and downstream from their homes. Journal of Fisheries Research Board of Canada 11:550-558.

Moffitt, C.M., and T.C. Bjornn. 1984. Fish abundance upstream from Dworshak Dam following exclusion of steelhead trout. Technical Completion Report, Idaho Water Energy Resources Research Institute, University of Idaho, Moscow, ID.

Piper, R.E. et. al. 1982. Fish hatchery management. United States Department of the Interior, Fish and Wildlife Service, Washington, DC.

Rieman, B.E., and K. Apperson 1989. Status and Analysis of Salmonid Fisheries, Westslope Cutthroat trout Synopsis and Analysis of Fishery Information. Job Completion Report, Project F-73-R-11, Subproject II, Job I, Idaho Department of Fish and Game, Boise.

APPENDIX A

Summary of mean densities and confidence intervals
for cutthroat, brook and bull trouts
in tributaries of Priest Lake
from 1983 to 1989

Table Al. Summary of mean densities and confidence intervals (a = 0.05) for cutthroat, brook, and bull trouts in all stocked and unstocked creeks that were studied in the Priest Lake drainage from 1983 to 1989.

	0pect.*000a												
Creek	cur$_t$				arkt				Bull				$_A$L$_L$
Tear	0	I	II	Total	0	I	II	Total	0	1	II	Total	Fishes
Blacictai I													
1983													
Mean	0.010	0.009	0.020	0.040	0.003	0.004	0.003	0.010	0.009	0.020	0.000	0.028	0.078
Samote Var	0.001	0.001	0.002	0.004	0.000	0.000	0.000	0.000	0.001	0.004	0.000	0.005	0.008
Continence interval	0.012	0.013	0.018	0.023	0.005	0.006	0.003	0.008	0.011	0.025	0.000	0.027	0.034
1984													
Mean	0.000	0.009	0.013	0.323	0.013	0.006	0.018	0.037	0.016	0.000	0.000	0.016	0.076
Saeote Var	0.200	0.000	0.001	0.002	0.000	0.000	0.001	0.002	0.001	0.000	0.000	0.001	0.005
Continence interval	0.000	0.012	0.018	0.030	0.014	0.011	0.020	0.032	0.017	0.000	0.000	0.017	0.047
1985													
Mean	0.403	0.050	0.017	0.469	0.067	0.014	0.017	0.098	0.012	0.000	0.021	0.033	0.600
Samote Var	0.177	0.007	0.003	0.275	0.010	0.002	0.003	0.022	0.002	0.000	0.002	0.006	0.421
Continence interval	0.261	0.052	0.033	0.325	0.062	0.028	0.033	0.091	0.024	0.000	0.028	0.049	0.402
1986													
Mean	0.455	0.045	0.045	0.545	0.086	0.061	0.087	0.234	0.000	0.000	0.000	0.000	0.778
Samote Ver	0.2'2	0.010	0.010	0.340	0.022	0.012	0.011	0.060	0.000	0.000	0.000	0.000	0.621
Cantinence interval	0.236	0.061	0.061	0.362	0.0 3	0.060	0.065	0.152	0.000	0.000	0.000	0.000	0.489
1987													
Mean	0.334	0.045	0.102	0.480	0.120	0.718	0.066	0.204	0.000	0.000	0.000	0.000	0.685
Samote Var	0.'53	0.005	0.039	0.147	0.021	0.002	0.012	0.041	0.000	0.000	0.000	0.000	0.193
Cant cence interval	0.247	0.046	0.122	0.238	0.090	0.026	0.067	0.126	0.000	0.000	0.000	0.000	0.272
1988													
Mean	0.202	0.023	0.193	0.418	0.086	0.134	0.206	0.425	0.000	0.000	0.000	0.000	0.843
Samote Var	0.092	0.005	0.078	0.160	0.020	0.020	0.042	0.157	0.300	0.000	0.000	0.000	0.412
Continence interval	0.199	0.346	0.182	0.261	0.093	0.094	0.134	0.259	0.000	0.000	0.000	0.000	0.419
1989													
Mean	0.144	0.077	0.085	0.306	0.047	0.014	0.022	0.084	0.000	0.000	0.200	0.000	0.366
Sainte Var	0.026	0.206	0.009	0.051	0.006	0.002	0.002	0.019	0.000	0.000	0.200	0.000	0.391
0000ioence interval	0.099	0.046	0.060	0.140	0.049	0.028	0.030	0.086	0.000	0.000	0.000	0.000	0.187
Cache													
1983													
Mean	0.000	0.007	0.004	0.011	0.027	0.019	0.031	0.076	0.008	0.000	0.000	0.008	0.096
Sartcte Var	0.000	0.001	0.001	0.002	0.004	0.302	0.005	0.013	0.002	0.000	0.000	0.002	0.022
Continence interval	0.000	0.010	0.009	0.018	0.023	0.015	0.026	0.041	0.015	0.000	0.000	0.015	0.053
198													
Mean	0.005	0.000	0.005	0.210	0.092	0.370	0.105	0.268	0.000	0.000	0.000	0.000	0.277
Sainte Var	0.000	0.000	0.000	0.001	0.006	0.006	0.029	0.072	0.000	0.000	0.000	0.000	0.068
CantiCenCC interval	0.009	0.000	0.009	0.019	0.052	0.053	0.118	0.186	0.000	0.000	0.000	0.000	0.181
1986													
Mean	0.303	0.000	0.000	0.303	0.017	0.000	0.000	0.017	0.000	0.000	0.000	0.000	0.320
Sainte Var	0.324	0.000	0.000	0.324	0.002	0.000	0.000	0.002	0.000	0.300	0.000	0.000	0.318
Continence interval	0.249	0.000	0.300	0.249	0.019	0.000	0.000	0.019	0.000	0.000	0.000	0.000	0.247
1987													
Mean	0.453	0.331	0.012	0.796	0.010	0.000	0.031	0.041	0.000	0.000	0.000	0.000	0.837
Samote Var	0.142	0.243	0.001	0.489	0.002	0.000	0.004	0.007	0.000	0.000	0.000	0.000	0.492
Confidence interval	0.161	0.211	0.016	0.299	0.019	0.000	0.027	0.037	0.000	0.000	0.000	0.000	0.300
198													
Meen	0.174	0.030	0.155	0.358	0.000	0.025	0.018	0.043	0.000	0.000	0.000	0.000	0.402
Sanale Var	0.043	0.002	0.049	0.109	0.000	0.005	0.003	0.015	0.000	0.000	0.000	0.000	0.103
Continence interval	0.098	0.023	0.105	0.157	0.000	0.033	0.025	0.058	0.000.	0.000	0.000	0.000	0.152
1989													
Mean	0.004	0.057	0.146	0.207	0.000	0.033	0.025	0.058	0.000	0.000	0.000	0.000	0.265
Samote Var	0.000	0.005	0.019	0.039	0.000	0.004	0.004	0.009	0.000	0.000	0.000	0.000	0.058
Continence interval	0.008	0.031	0.059	0.084	0.300	0.026	0.028	0.040	0.000	0.000	0.000	0.000	0.103
Jost													
1983													
Mean	0.008	0.021	0.000	0.029	0.021	0.036	0.050	0.108	0.002	0.000	0.000	0.002	0.138
Sannte Var	0.003	0.011	0.000	0.013	0.004	0.008	0.014	0.027	0.000	0.000	0.000	0.000	0.034
Continence interval	0.314	0.028	0.000	0.031	0.018	0.024	0.032	0.044	0.003	0.000	0.000	0.003	0.050
1984													
Mean	0.000	0.000	0.000	0.000	0.032	0.058	0.085	0.175	0.000	0.000	0.000	0.000	0.175
Saeete Var	0.000	0.000	0.000	0.000	0.006	0.013	0.011	0.032	0.000	0.000	0.000	0.000	0.032
000000ence interval	0.000	0.000	0.000	0.000	0.062	0.091	0.082	0.143	0.000	0.000	0.000	0.000	0.143
1985													
Mean		0.081	0.000	0.258	0.035	0.111	0.063	0.209	0.000	0.000	0.000	0.000	0.468
Sainte Var	0.040	0.101	0.000	0.199	0.013	0.045	0.326	0.098	0.000	0.000	0.000	0.000	0.450
Cant i 0e0ce interval	0.090	0.143	0.000	0.201	0.051	0.0%	0.073	0.141	0.000	0.000	0.000	0.000	0.303
1986													
Mean	0.097	0.016	0.066	0.178	0.027	0.062	0.130	0.219	0.000	0.000	0.000	0.000	0.397
Samote	0.066	0.005	0.027	0.088	0.007	0.028	0.059	0.139	0.000	0.000	0.000	0.000	0.150
Confidence interval		0.115		0.073	0.133	0.075	0.109	0.168	0.000	0.000	0.000	0.000	0.174
1987													
Mean		0.000		0.153	0.180	0.118	0.113	0.272	0.000	0.000	0.000	0.000	0.452
Sainte Var		0.000		0.165	0.164	0.061	0.036	0.090	0.000	0.000	0.000	0.000	0.197
Continence interval		0.000		0.173	0.177	0.108	0.063	0.131	0.000	0.000	0.000	0.000	0.194
1988													
Mean		0.000		0.015	0.015	0.107	0.090	0.197	0.000	0.000	0.000	0.000	0.212
Barite Var		0.000		0.004	0.004	0.046	0.026	0.052	0.000	0.000	0.000	0.000	0.050
C0n0i0enee interval		0.000		0.029	0.029	0.094		0.071	0.100	0.000	0.000	0.000	0.098
1989													
Mean		0.000		0.060	0.060	0.092		0.052	0.271	0.000	0.000	0.000	0.331
Serrate Var		0.000		0.042	0.042	0.027	C.113	0.087	0.000	0.000	0.000	0.000	0.133
Continence interval,		0.000		0.089	0.089	0.071	0.050	0.129	0.000	0.000	0.000	0.000	0.160

Creek Year		apecieslace												All Fishes
		Curt								Bull				
		0		II	Total	0	I	II	Total	0	I	II	Total	
Packer														
1983	**Mean**	0.000	0.000	0.010	0.010	0.000	0.000	0.000	0.000	0.003	0.000	0.000	0.003	0.013
	Samote Var	0.000	0.000	0.004	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.004
	Confidence interval	0.000	0.000	0.020	0.020	0.000	0.000	0.000	0.000	0.006	0.000	0.000	0.006	0.020
1984	**Mean**	0.000	0.000	0.104	0.104	0.000	0.000	0.000	0.000	0.000	0.003	0.000	0.000	0.104
	Sainte Var	0.000	0.000	0.018	0.018	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.018
	Cantioence **interval**	0.000	0.000	0.100	0.100	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.100
1985	**Mean**	0.306	0.487	0.104	0.897	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.897
	Samote Var	1.634	0.504	0.054	1.986	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.986
	Confidence interval	0.575	0.319	0.105	0.634	0.000	0.000	0.000	0.000	0.000	0.000	3.000	0.000	0.634
1986	**Mean**	0.147	0.255	0.282	0.684	0.000	0.000	0.000	0.000	0.000	0.000	3.000	0.000	0.684
	Samote Var	0.135	0.191	0.120	0.569	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.569
	Confidence interval	0.161	0.191	0.152	0.330	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.330
1987	Mean	0.601	0.167	0.097	0.865	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.865
	Samote Var	1.567	0.107	0.032	2.191	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.191
	Confidence i nt **erva l**	0.491	0.128	0.070	0.580	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.580
1988	**Mean**	1.638	0.031	0.383	2.052	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.052
	Sample Var	29.958	0.006	0.335	29.027	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	29.027
	Confidence interval	2.146	0.031	0.227	2.112	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.000	2.112
1989	**Mean**	0.009	0.046	0.170	0.225	0.000	0.000	0.000	0.000	.0.000	0.000	0.000	0.000	0.225
	Samote Var	0.002	0.011	0.066	0.366	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.066
	Confidence interval	0.018	0.038	0.094	0.094	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.094
Zero														
1983	**Mean**	0.001	0.038	0.127	0.167	0.000	0.000	0.001	0.002	0.000	0.000	0.700	0.000	0.168
	Sainte Var	0.000	0.003	0.014	0.020	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.020
	Confidence interval	0.002	0.017	0.038	0.044	0.000	0.001	0.002	0.003	0.000	0.000	0.000	0.000	0.045
1984	**Mean**	0.003	0.004	0.089	0.096	0.000	0.000	0.007	0.007	0.000	0.000	7.000	0.000	0.103
	Sandie Var	0.000	0.000	0.006	0.007	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.007
	Confidence interval	0.006	0.008	0.059	0.064	0.000	0.000	0.013	0.013	0.000	0.000	0.000	0.000	0.062
1985	**Mean**	0.908	0.004	0.174	1.786	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.086
	Samote Var	4.222	0.000	0.058	4.924	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	4.924
	Confidence interval	0.901	0.008	0.106	0.972	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.972
1986	**Mean**	0.000	0.282	0.039	0.322	0.000	0.000	0.000	0.000	0.000	0.000	0.700	0.000	0.322
	Sample Var	0.000	0.295	0.007	0.298	0.000	0.000	0.000	0.000	0.000	0.000	3.000	0.000	0.298
	Confidence interval	0.000	0.198	0.030	0.199	0.000	0.000	0.000	0.000	0.000	0.000	7.300	0.000	0.199
1987	**Mean**	0.231	0.041	0.215	0.487	0.000	0.004	0.004	0.008	0.000	0.000	0.000	0.000	0.495
	Smote Ver	0.208	0.008	0.087	0.378	0.000	0.000	0.000	0.002	0.000	0.000	3.000	0.000	0.384
	Confidence **interval**	0.172	0.034	0.111	0.232	0.000	0.008	0.008	0.015	0.000	0.000	0.000	0.000	0.234
1988	**Mean**	0.276	0.008	0.362	0.647	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.647
	Smote Var	0.345	0.001	0.143	0.516	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.516
	Confidence interval	0.230	0.011	0.148	0.282	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.282
Beaver														
1983	**Mean**	0.000	0.000	0.001	0.001	0.062	0.011	0.035	0.108	0.000	0.000	0.000	0.000	0.109
	Samote Var	0.000	0.000	0.000	0.000	0.021	0.000	0.010	0.027	0.000	0.000	0.300	0.000	0.027
	Confidence interval	0.000	0.000	0.002	0.002	0.063	0.009	0.043	0.072	0.000	0.000	0.000	0.000	0.072
1984	**Mean**	0.000	0.093	0.089	0.182	0.046	0.019	0.047	0.112	0.000	0.000	0.700	0.000	0.294
	Smote Vs'	0.000	0.025	0.018	0.076	0.005	0.001	0.003	0.014	0.000	0.000	3.700	0.000	0.044
	Confidence interval	0.000	0.103	0.087	0.180	0.047	0.016	0.037	0.078	0.000	0.000	0.000	0.000	0.137
1987	**Mean**	0.010	0.108	0.066	0.183	0.104	0.060	0.089	0.253	0.000	0.000	0.700	0.000	0.436
	Samote Var	0.001	0.017	0.005	0.020	0.020	0.003	0.010	0.038	0.000	0.000	0.000	0.000	0.039
	Confidence interval	0.019	0.081	0.044	0.087	0.088	0.034	0.063	0.121	0.000	0.000	0.000	0.000	0.123
1988	**Mean**	0.012	0.030	0.050	0.091	0.030	0.009	0.017	0.055	0.000	0.000	0.000	0.000	0.147
	Sandie Var	0.001	0.002	0.009	0.013	0.002	0.001	0.001	0.002	0.000	0.000	0.000	0.000	0.009
	Confidence interval	0.018	0.029	0.059	0.070	0.030	0.017	0.017	0.027	0.000	0.000	0.000	0.000	0.059
1989	**Mean**	0.052	0.025	0.011	0.087	0.004	0.051	0.028	0.083	0.000	0.003	0.000	0.003	0.173
	Smote Var	0.003	0.001	0.000	0.004	0.000	0.005	0.001	0.006	0.000	0.000	0. 00	0.000	0.008
	Confidence interval	0.035	0.014	0.011	0.040	0.008	0.045	0.021	0.047	0.000	0.006	0.000		

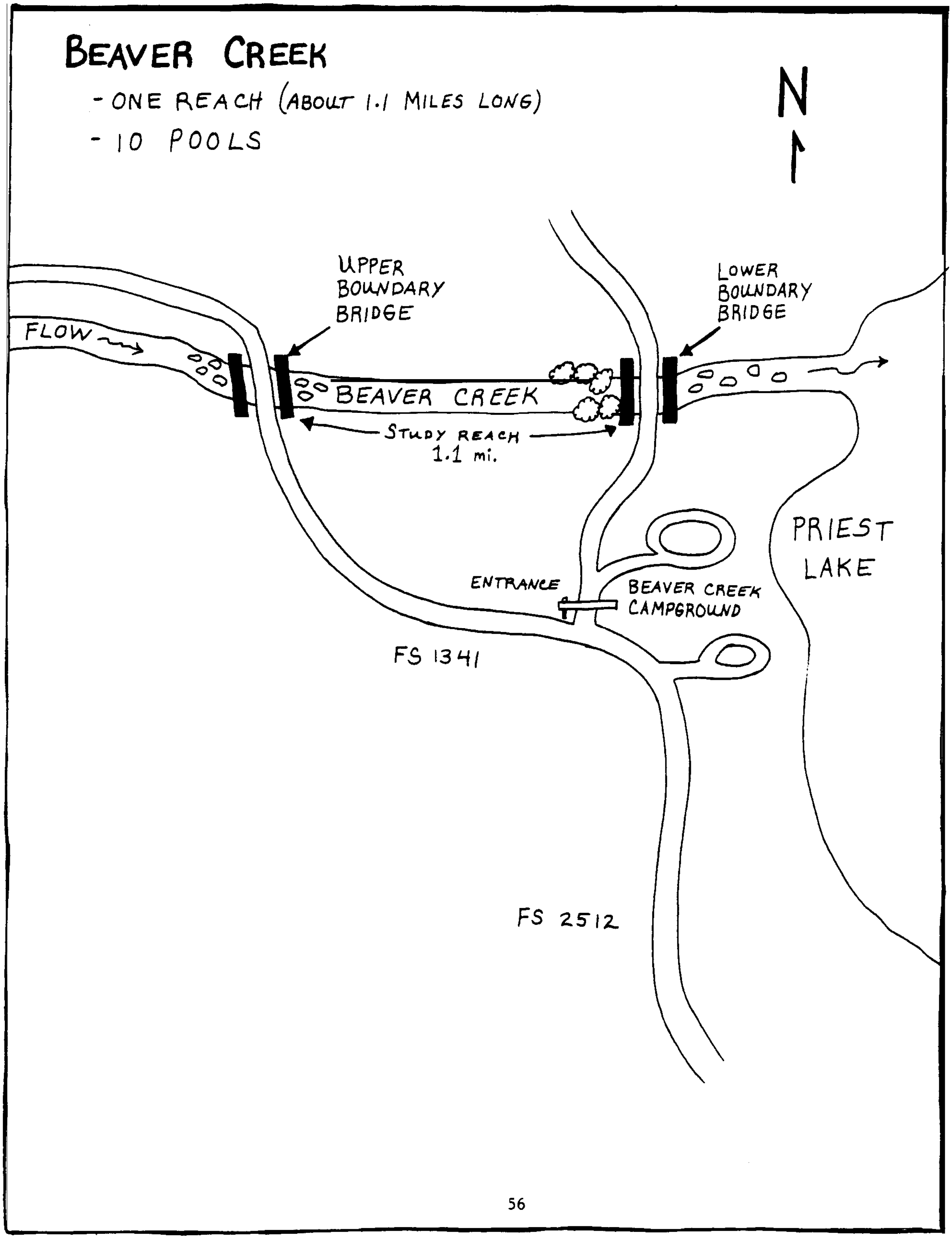
Creek Year		apecteslage												
		Cott								Bull				All
		0	1	II	Total	0	1	II	Total	0	1	II	Total	Fishes
SF Granite														
	Mean	0.000	0.003	0.011	0.014	0.020	0.014	0.035	0.069	0.000	0.000	0.001	0.001	0.084
	Sanole Var	0.000	0.000	0.001	0.001	0.002	0.000	0.006	0.016	0.000	0.000	0.000	0.000	0.019
	Confidence interval	0.001	0.005	0.012	0.016	0.022	0.011	0.040	0.064	0.000	0.000	0.001	0.001	0.070
1984														
	Mean	0.009	0.016	0.046	0.072	0.001	0.006	0.006	0.013	0.001	0.000	0.005	0.006	0.091
	Sanote Var	0.000	0.001	0.003	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.010
	Confidence interval	0.009	0.014	0.029	0.043	0.002	0.009	0.008	0.013	0.003	0.000	0.005	0.007	0.056
1985														
	Mean	0.040	0.000	0.000	0.040	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.040
	Smote Var	0.001	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
	Confioence interval	0.020	0.000	0.000	0.020	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.020
1986														
	Mean	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Smote Var	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Confidence interval	0.300	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1987														
	Mean	0.000	0.005	0.001	0.006	0.002	0.009	0.006	0.017	0.000	0.026	0.001	0.027	0.050
	Saaote Var	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.003	0.000	0.003	0.003
	Confidence interval	0.700	0.010	0.002	0.010	0.004	0.012	0.011	0.018	0.000	0.033	0.003	0.032	0.035
[illegible]														
	Mean	0.000	0.000	0.018	0.018	0.000	0.000	0.003	0.003	0.000	0.000	0.002	0.002	0.023
	Samote Var	0.000	0.000	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
	Confioence interval	0.000	0.000	0.014	0.014	0.000	0.000	0.006	0.006	0.000	0.000	0.003	0.003	0.016
Caribou														
1987														
	Mean	0.005	0.001	0.002	0.008	0.000	0.009	0.012	0.021	0.000	0.000	0.000	0.000	0.029
	Smote Var	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.001
	Confidence	0.310	(I.011	0.002	0.012	0.000	0.007	0.010	0.015	0.000	0.000	0.000	0.000	0.018
1988														
	Mean	0.000	0.001	0.005	0.006	0.008	0.004	0.017	0.029	0.000	0.000	0.000	0.000	0.036
	Samnte Var	0.700	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.000	0.000	0.000	0.000	0.001
	Confidence	0.000	0.003	0.008	0.008	0.012	0.004	0.018	0.019	0.000	0.000	0.000	0.000	0.022
Granite (Main)														
1987														
	Mean	0.000	0.000	0.008	0.008	0.000	0.000	0.000	0.000	0.000	0.000	0.006	0.006	0.013
	Sample Var	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Confiden	0.000	0.000	0.005	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.005	0.005	0.006
1988														
	Mean	0.000	0.000	0.011	0.011	0.000	0.002	0.005	0.007	0.000	0.000	0.002	0.002	0.020
	Samdte Var	0.300	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Confiden	0.000	0.000	0.008	0.008	0.000	0.003	0.007	0.007	0.000	0.000	0.002	0.002	0.013
1989														
	Mean	0.000	0.001	0.002	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.003
	Satmte Var	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Confidence interval	0.000	0.001	0.003	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.003
1u8	Fork													
	Mean	0.005	0.008	0.036	0.049	0.000	0.000	0.000	0.000	0.000	0.006	0.021	0.027	0.076
	Smote Var	0.000	0.000	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.002	0.003
	Confioence interval	0.008	0.008	0.019	0.021	0.000	0.000	0.000	0.000	0.000	0.008	0.031	0.031	0.032
1988														
	Mean	0.000	0.007	0.031	0.038	0.000	0.000	0.009	0.009	0.000	0.004	0.005	0.009	0.057
	Sanole Var	0.000	0.000	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002
	Confidence interval	0.000	0.007	0.014	0.016	0.000	0.000	0.013	0.013	0.000	0.007	0.007	0.013	0.029
Indian														
1983	Mean	0.000	0.001	0.224	0.226	0.000	0.000	0.014	0.014	0.000	0.000	0.009	0.009	0.248
	Sancta Var	0.000	0.000	0.036	0.035	0.000	0.000	0.001	0.001	0.000	0.000	0.000	0.000	0.056
	Confidence interval	0.000	0.002	0.151	0.150	0.000	0.000	0.027	0.027	0.000	0.000	0.018	0.018	0.189
1987	Mean	0.023	0.014	0.077	0.114	0.016	0.009	0.023	0.047	0.016	0.012	0.021	0.049	0.210
	Samdte Var	0.004	0.001	0.006	0.010	0.001	0.000	0.003	0.005	0.001	0.001	0.003	0.005	0.047
	Confidence interval	0.036	0.019	0.046	0.062	0.021	0.013	0.034	0.045	0.021	0.019	0.034	0.045	0.135
1988	Mean	0.005	0.008	0.148	0.161	0.000	0.011	0.010	0.021	0.000	0.000	0.000	0.000	0.182
	Sanole Var	0.000	0.000	0.046	0.043	0.000	0.001	0.000	0.003	0.000	0.000	0.000	0.000	0.049
	Confidence interval	0.011	0.011	0.133	0.128	0.000	0.022	0.013	0.033	0.000	0.000	0.000	0.000	0.137
1989	Mean	0.010	0.007	0.083	0.100	0.000	0.000	0.000	0.000	0.003	0.000	0.000	0.003	0.102
	Smote Var	0.000	0.000	0.005	0.006	0.00'	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.006
	Confidence interval	0.014	0.010	0.045	0.048	0.0[0]	0.000	0.000	0.000	0.005	0.000	0.000	0.005	0.047

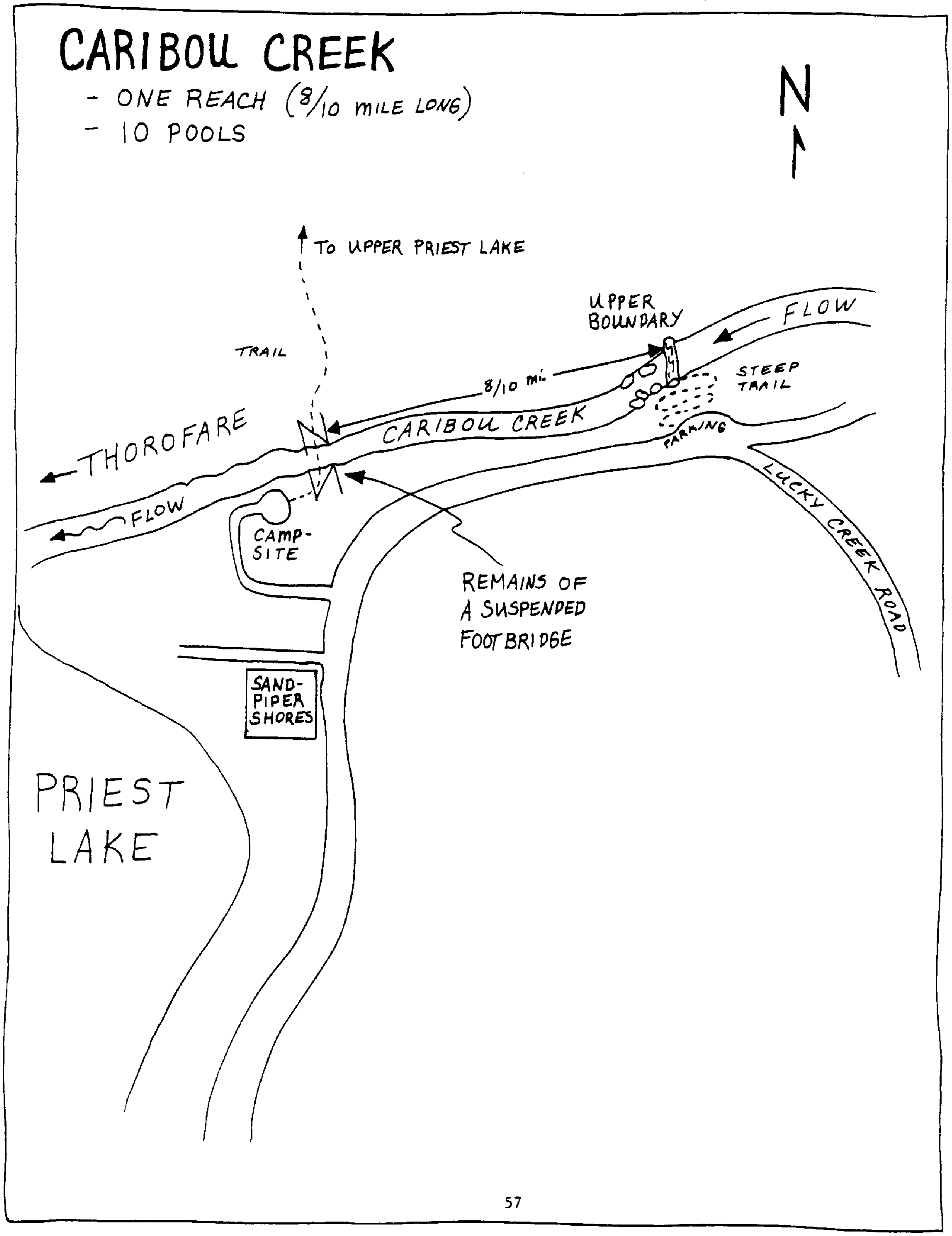
Creek Year		Cutt 0	Cutt I	Cutt II	Cutt Total	0	I	II	Total	Bull 0	Bull I	Bull 11	Bull Total	All Fishes
		apec tes! arse												
Kalispell														
1983	Mean	0.001	0.005	0.017	0.024	0.042	0.030	0.065	0.136	0.000	0.000	0.000	0.000	0.160
	Samote Var	0.000	0.000	0.002	0.002	0.006	0.002	0.012	0.041	0.000	0.000	0.000	0.000	0.051
	Confidence interval	0.001	0.005	0.011	0.012	0.020	0.013	0.029	0.054	0.000	0.000	0.000	0.000	0.061
1987	Mean	0.075	0.060	0.023	0.158	0.024	0.118	0.052	0.194	0.000	0.000	0.000	0.000	0.352
	Sainte Var	0.010	0.014	0.002	0.053	0.006	0.031	0.008	0.053	0.000	0.000	0.700	0.000	0.167
	Confidenceinterval	0.062	0.074	0.030	0.142	0.047	0.110	0.056	0.146	0.000	0.000	0.000	0.000	0.253
1988	Mean	0.000	0.000	0.000	0.000	0.041	0.036	0.129	0.206	0.000	0.000	0.700	0.000	0.206
	Sample Var	0.000	0.000	0.000	0.000	0.008	0.006	0.035	0.077	0.000	0.000	0.000	0.000	0.077
	Confidenceinterval	0.000	0.000	0.000	0.000	0.054	0.047	0.116	0.172	0.000	0.000	0.700	0.000	0.17Z
Lion														
1983	Mean	0.000	0.000	0.008	0.008	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.008
	Sainte Var	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Confidenceinterval	0.000	0.000	0.006	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.006
1987	Mean	0.002	0.003	0.059	0.064	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.001	0.065
	Samote Var	0.000	0.000	0.004	0.004	0.000	0.000	0.000	0.000	0.000	0.000	3.000	0.000	0.004
	Confidenceinterval	0.003	0.005	0.038	0.038	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.001	0.038
1988	Mean	0.021	0.000	0.124	0.144	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.003	0.148
	Samote Var	0.003	0.000	0.009	0.008	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.008
	Confidenceinterval	0.033	0.000	0.059	0.056	0.000	0.000	0.000	0.000	0.000	0.000	0.006	0.006	0.057
Soldier														
1987	Mean	0.000	0.000	0.000	0.000	0.007	0.022	0.109	0.138	0.000	0.000	7.701	0.001	0.139
	Samote Var	0.000	0.000	0.000	0.000	0.000	0.002	0.026	0.046	0.000	0.000	0.000	0.000	0.047
	Confidence interval	0.000	0.000	0.000	0.000	0.011	0.025	0.100	0.133	0.000	0.000	0.002	0.002	0.134
1988	Mean	0.000	0.018	0.006	0.024	0.069	0.012	0.122	0.203	0.000	0.000	0.700	0.000	0.226
	Samote Var	0.000	0.001	0.000	0.002	0.022	0.001	0.019	0.053	0.000	0.000	0.000	0.000	0.047
	Confidenceinterval	0.000	0.021	0.012	0.028	0.092	0.016	0.085	0.142	0.000	0.000	0.000	0.000	0.134
Two Mouth														
1983	Mean	0.004	0.000	0.000	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.004
	Samote Var	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Confidenceinterval	0.008	0.000	0.000	0.008	0.000	0.000	0.000	0.000	0.000	0.000	7.700	0.000	0.008
1987	Mean	0.025	0.014	0.129	0.169	0.000	0.000	0.002	0.002	0.000	0.000	0.000	0.000	0.170
	Samote Var	0.001	0.000	0.021	0.022	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.022
	Confidence interval	0.017	0.012	0.090	0.092	0.000	0.000	0.003	0.003	0.000	0.000	0.000	0.000	0.091
1988	Mean	0.000	0.005	0.118	0.123	0.000	0.001	0.003	0.004	0.000	0.000	0.002	0.002	0.130
	Samote Var	0.000	0.000	0.017	0.019	0.000	0.000	0.000	0.000	0.000	0.000	0.700	0.000	0.019
	Confidence interval	0.000	0.006	0.080	0.085	0.000	0.002	0.006	0.006	0.000	0.000	0.003	0.003	0.086
1989	Mean	0.030	0.020	0.090	0.140	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.150
	Samote Var	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Confioence interval	0.030	0.010	0.030	0.040	0.000	0.000	0.000	0.000	0.000	0.000	7.000	0.000	0.040
Trapper														
1983	Mean	0.040	0.000	0.099	0.140	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.140
	Samote Var	0.002	0.000	0.017	0.012	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.012
	Confidenceinterval	0.030	0.000	0.085	0.072	0.000	0.000	0.000	0.000	0.000	0.000	7.300	0.000	0.072
1987	Mean	0.000	0.070	0.081	0.150	0.000	0.000	0.000	0.000	0.004	0.009	0.000	0.013	0.164
	Sample Var	0.000	0.012	0.013	0.036	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.001	0.040
	Confidenceinterval	0.000	0.069	0.069	0.118	0.000	0.000	0.000	0.000	0.009	0.014	0.700	0.015	0.124
1988	Mean	0.000	0.024	0.219	0.243	0.000	0.000	0.000	0.000	0.000	0.006	0.005	0.011	0.254
	Smote Var	0.000	0.001	0.055	0.061	0.000	0.000	0.000	0.000	0.000	0.000	0.700	0.001	0.066
	Confidenceinterval	0.000	0.022	0.145	0.153	0.000	0.000	0.000	0.000	0.000	0.012	0.010	0.015	0.160
Upper Priest River														
1987	Mean	0.000	0.000	0.003	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.003
	Sample Var	0.000	0.000	0.000	0.000	0.000	0.000	0.'100	0.000	0.000	0.000	0.000	0.000	0.000
	Confidence interval	0.000	0.000	0.003	0.003	0.000	0.000	0.000	0.000	0.001	0.000	0.001	0.001	0.004
1988	Mean	0.000	0.000	0.001	0.001	0.000	0.000	c.000	0.000	0.000	0.001	0.000	0.001	0.002
	Smote Var	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Confidence interval	0.000	0.000	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.003	0.000	0.003	0.003

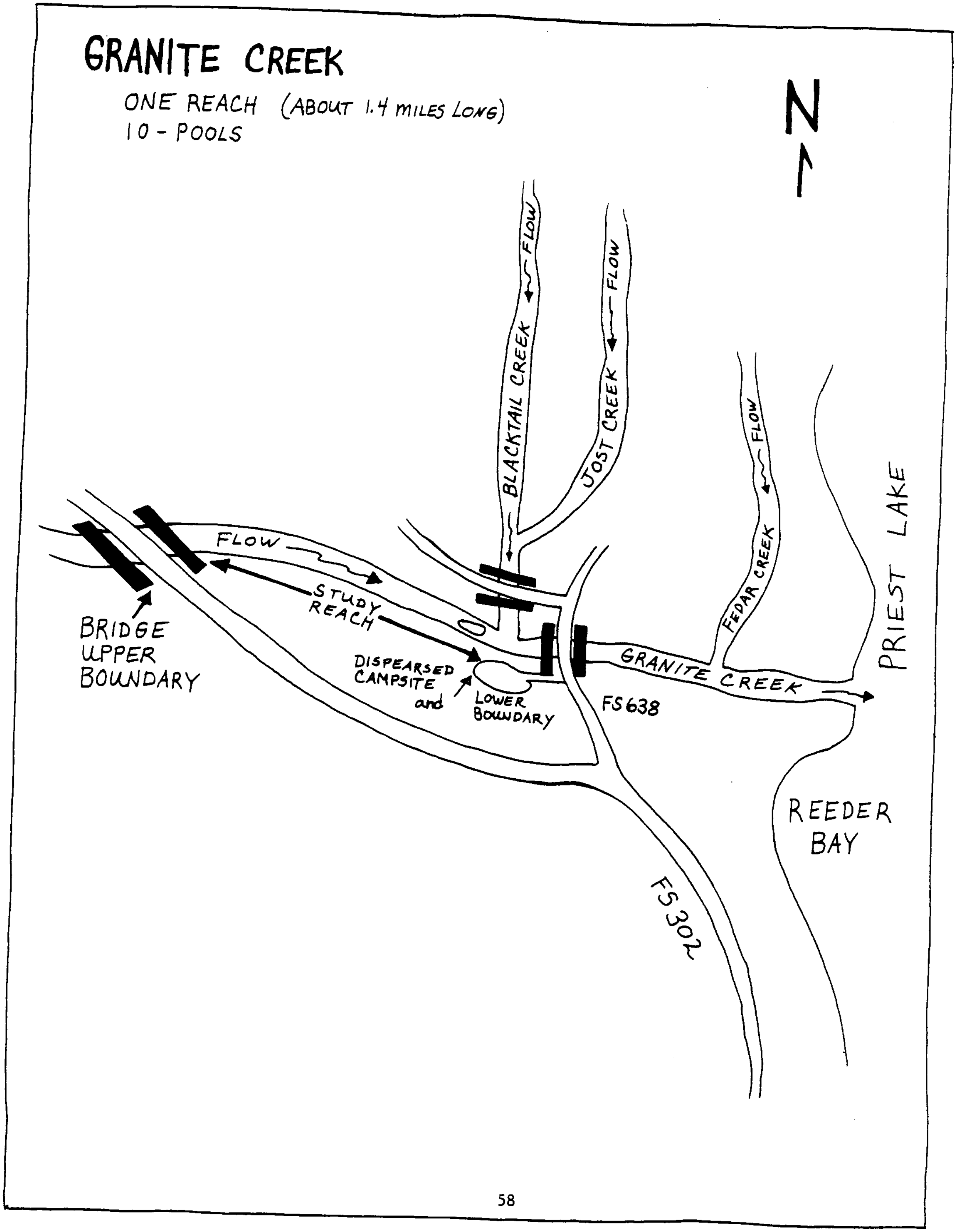
Creek Year	species/age												
	Cott								Mull				
	0	I	II	Total	0	I	I1	Total	0		II	Total	Fisnes
MF Granite													
1983													
Mean	0.000	0.002	0.011	0.014	0.000	0.000	0.006	0.006	0.005	0.005	0.009	0.019	0.039
Sam°le Var	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001
Confidence interval	0.000	0.002	0.009	0.009	0.001	0.000	0.005	0.005	0.006	0.004	0.006	0.011	0.016
1987													
Mean	0.000	0.000	0.000	0.000	0.012	0.007	0.000	0.019	0.000	0.000	0.000	0.000	
Sam°le Var	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	
Confidence interval	0.000	0.000	0.000	0.000	0.019	0.009	0.000	0.028	0.000	0.000	0.000	0.000	
1988													
Mean	0.000	0.000	0.000	0.000	0.004	0.005	0.000	0.009	0.000	0.000	0.000	0.000	
Sande Var	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Confidence interval	0.000	0.000	0.000	0.000	0.009	0.010	0.000	0.011	0.000	0.000	0.000	0.000	

APPENDIX B

Locations of study reaches for
streams closed to angling

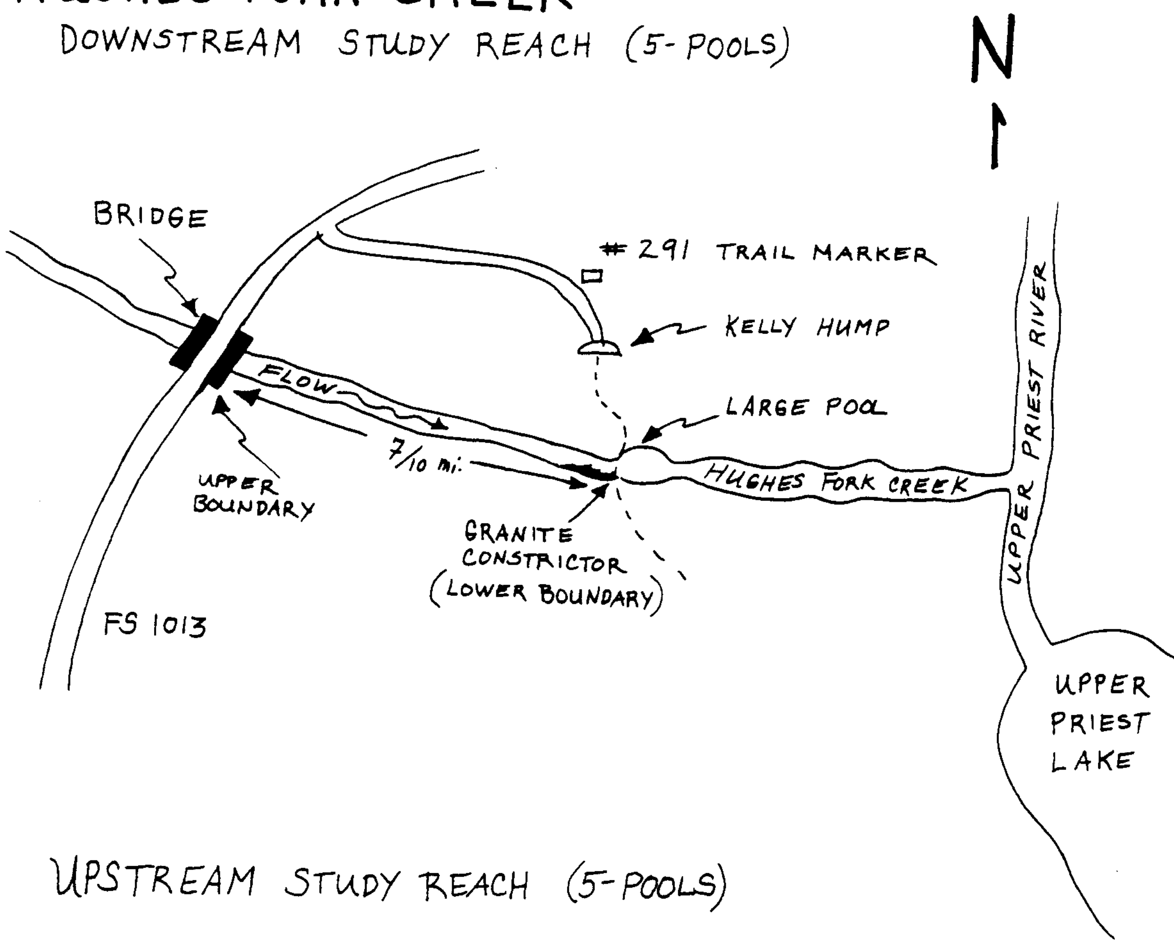

BEAVER CREEK
- ONE REACH (ABOUT 1.1 MILES LONG)
- 10 POOLS
N
UPPER BOUNDARY BRIDGE
LOWER BOUNDARY BRIDGE
FLOW
BEAVER CREEK
STUDY REACH
1.1 mi.
PRIEST LAKE
ENTRANCE
BEAVER CREEK CAMPGROUND
FS 1341
FS 2512


CARIBOU CREEK
- ONE REACH (8/10 mile LONG)
- 10 POOLS
N
TO UPPER PRIEST LAKE
TRAIL
UPPER BOUNDARY
FLOW
8/10 mi.
STEEP TRAIL
THOROFARE
CARIBOU CREEK
PARKING
FLOW
LUCKY CREEK ROAD
CAMP-SITE
REMAINS OF A SUSPENDED FOOTBRIDGE
SAND-PIPER SHORES
PRIEST LAKE

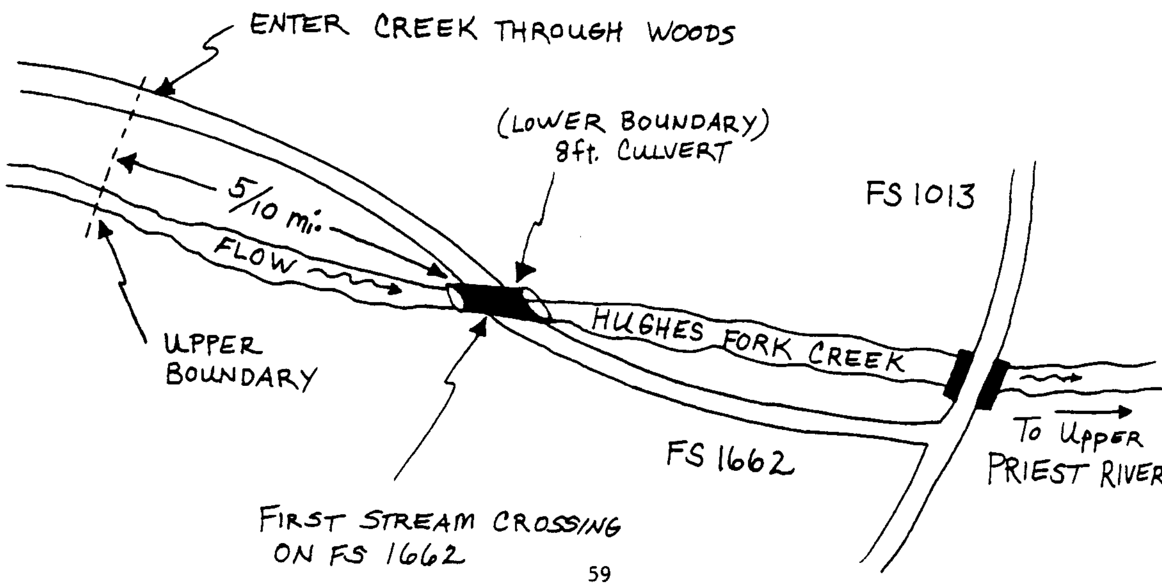

GRANITE CREEK
ONE REACH (ABOUT 1.4 MILES LONG)
10 - POOLS
N
BLACKTAIL CREEK
FLOW
JOST CREEK
FLOW
FEDAR CREEK
FLOW
PRIEST LAKE
FLOW
STUDY REACH
BRIDGE UPPER BOUNDARY
DISPEARSED CAMPSITE and LOWER BOUNDARY
GRANITE CREEK
FS 638
REEDER BAY
FS 302

HUGHES FORK CREEK

DOWNSTREAM STUDY REACH (5-POOLS)

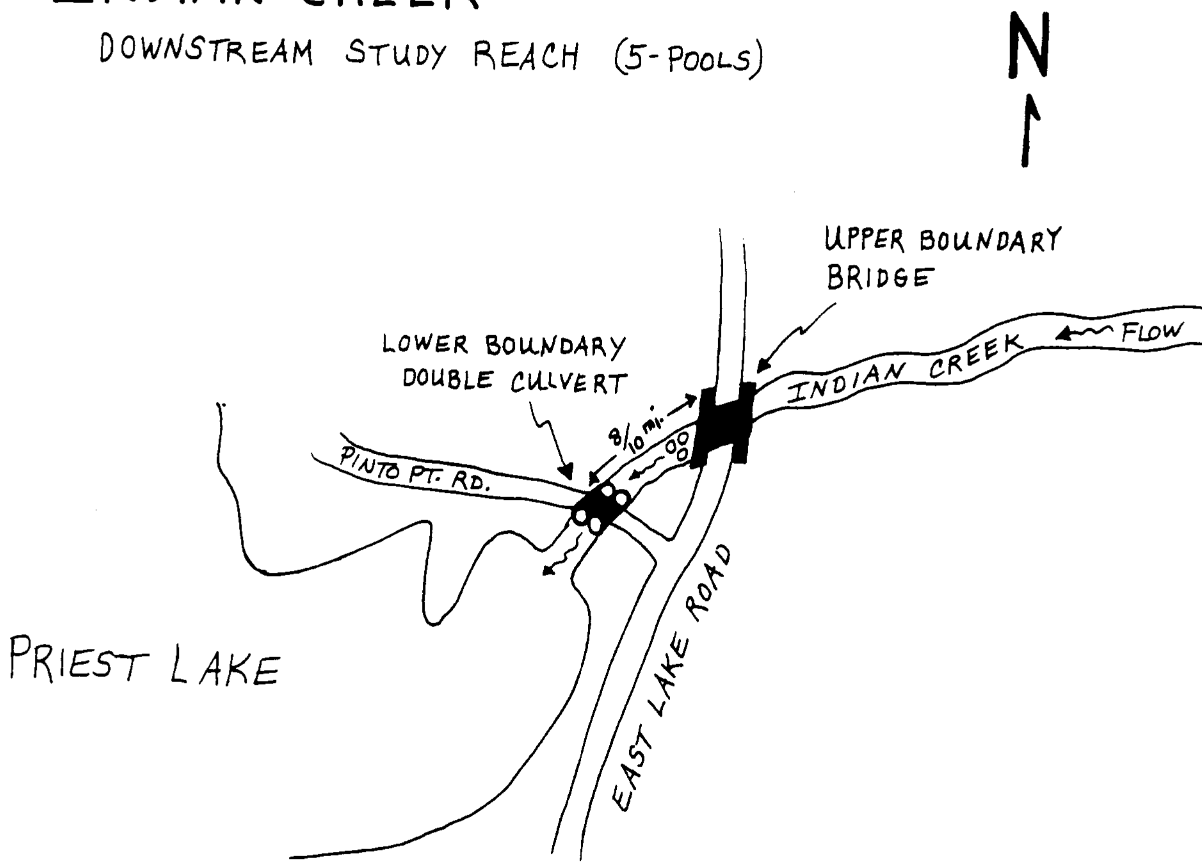


UPSTREAM STUDY REACH (5-POOLS)

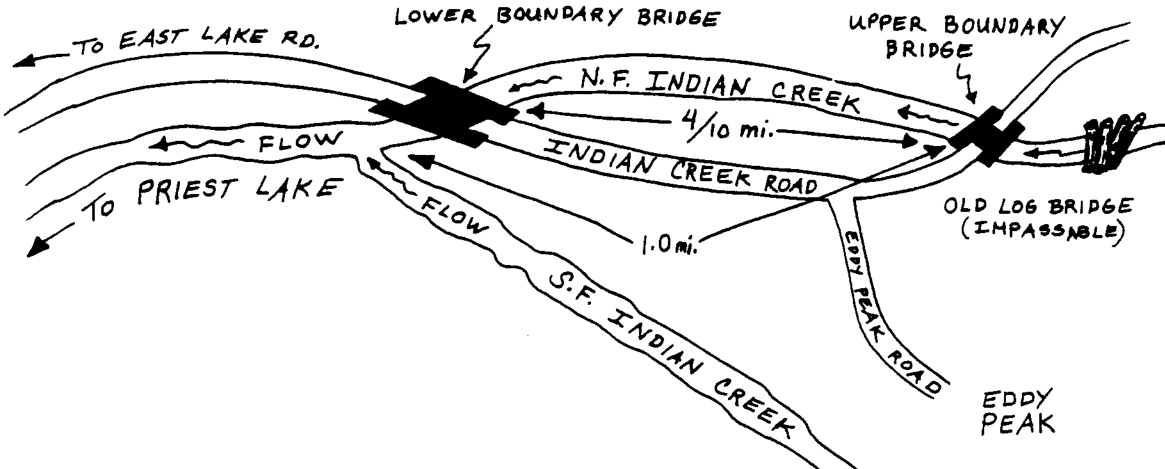


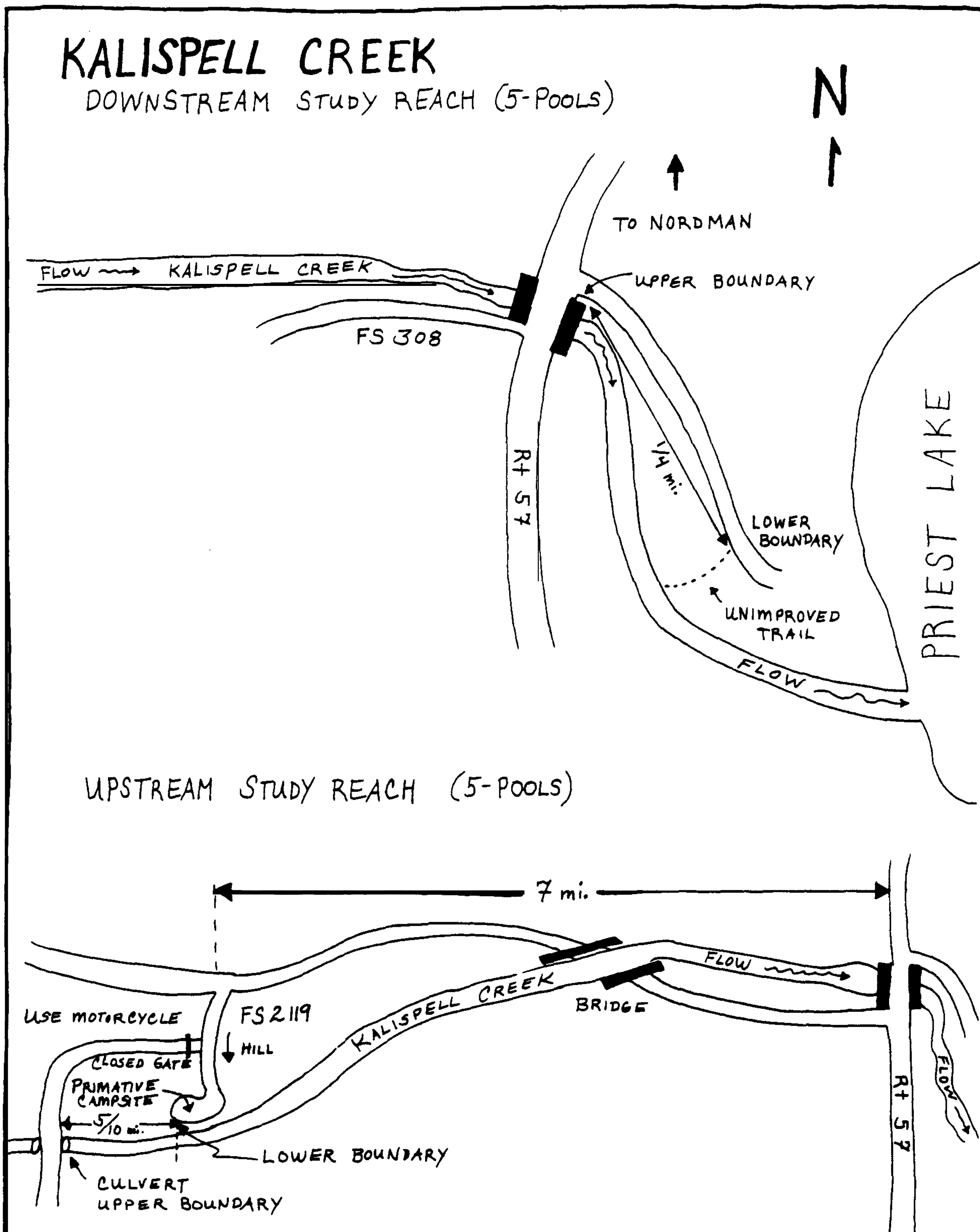
INDIAN CREEK

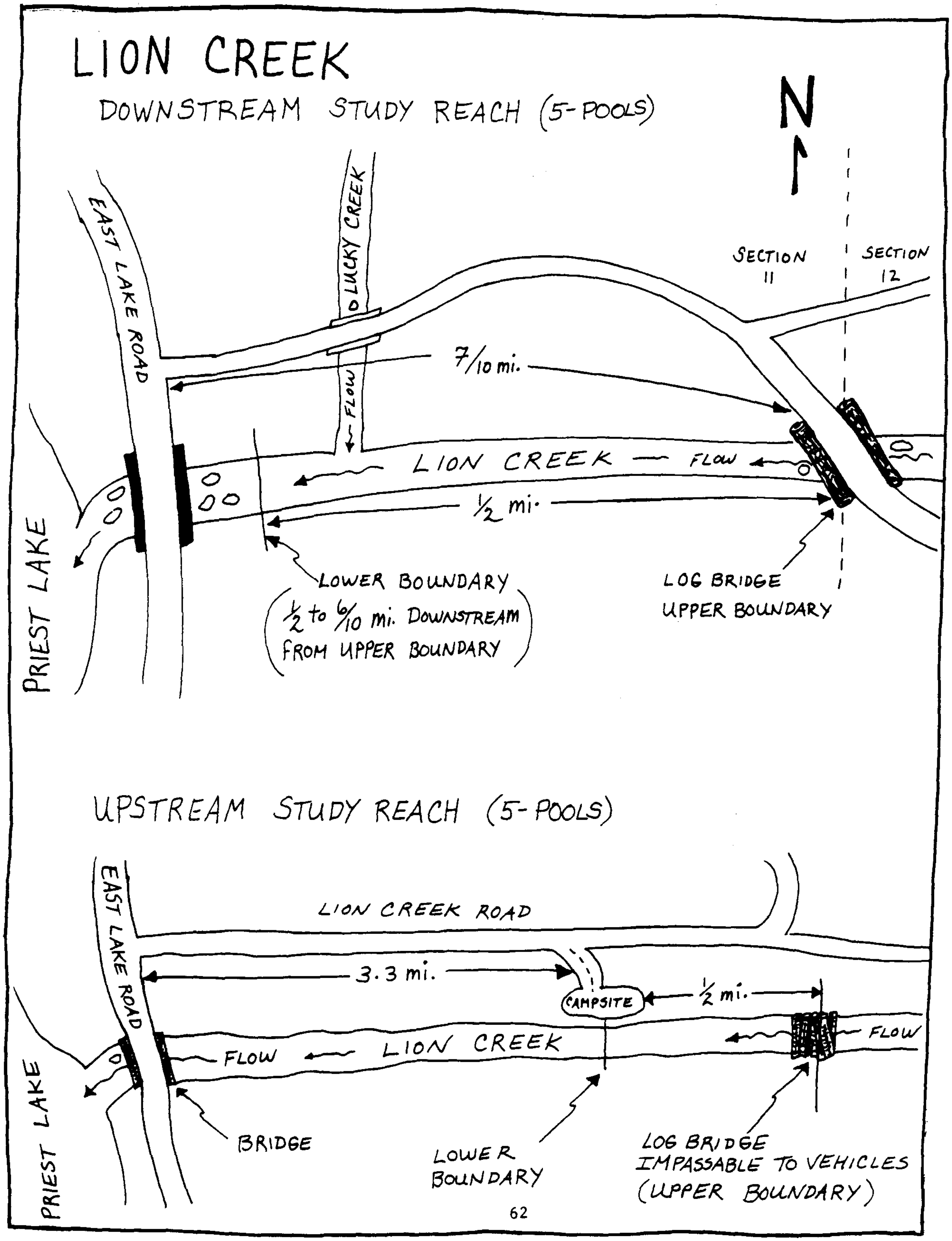
DOWNSTREAM STUDY REACH (5-POOLS)

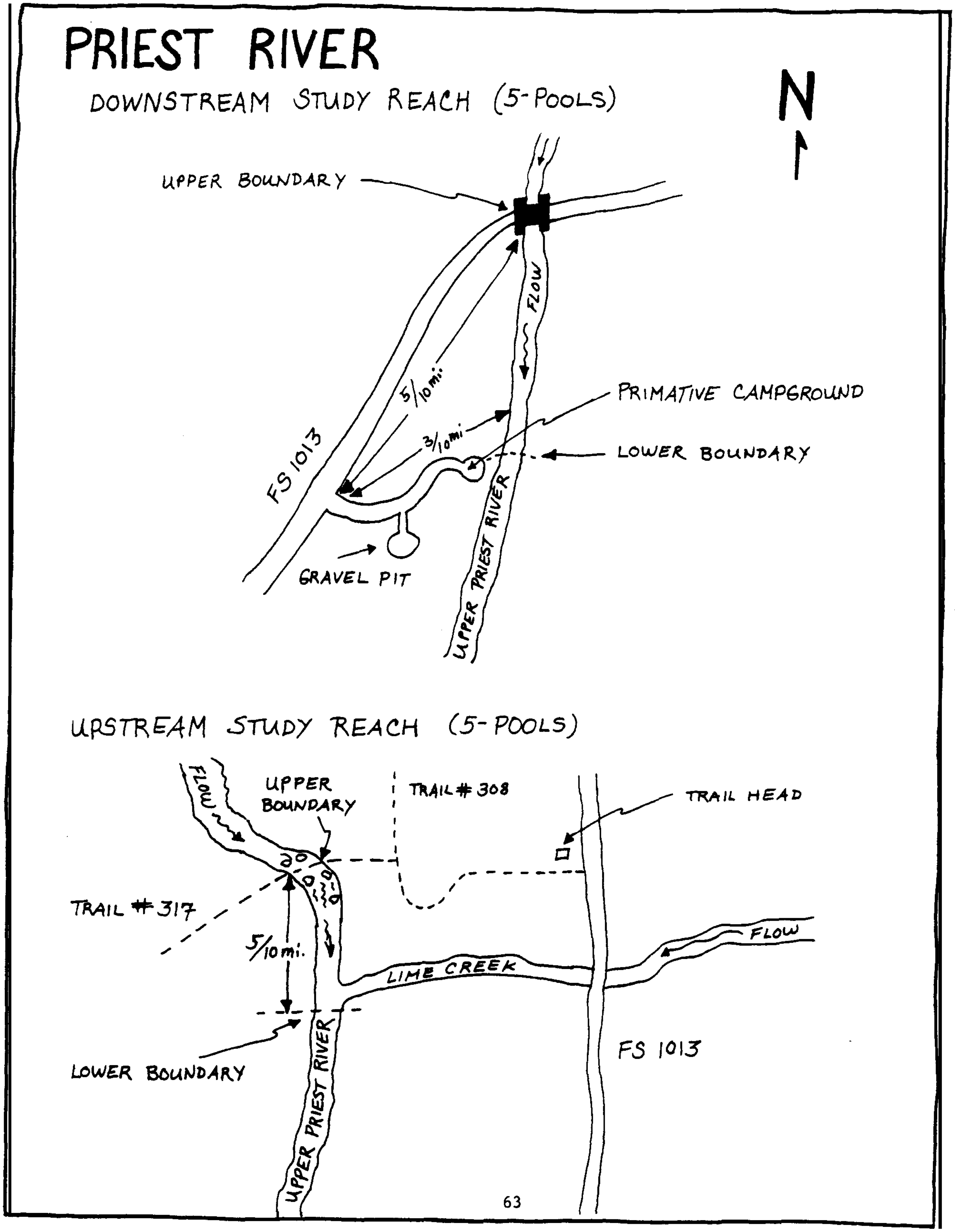


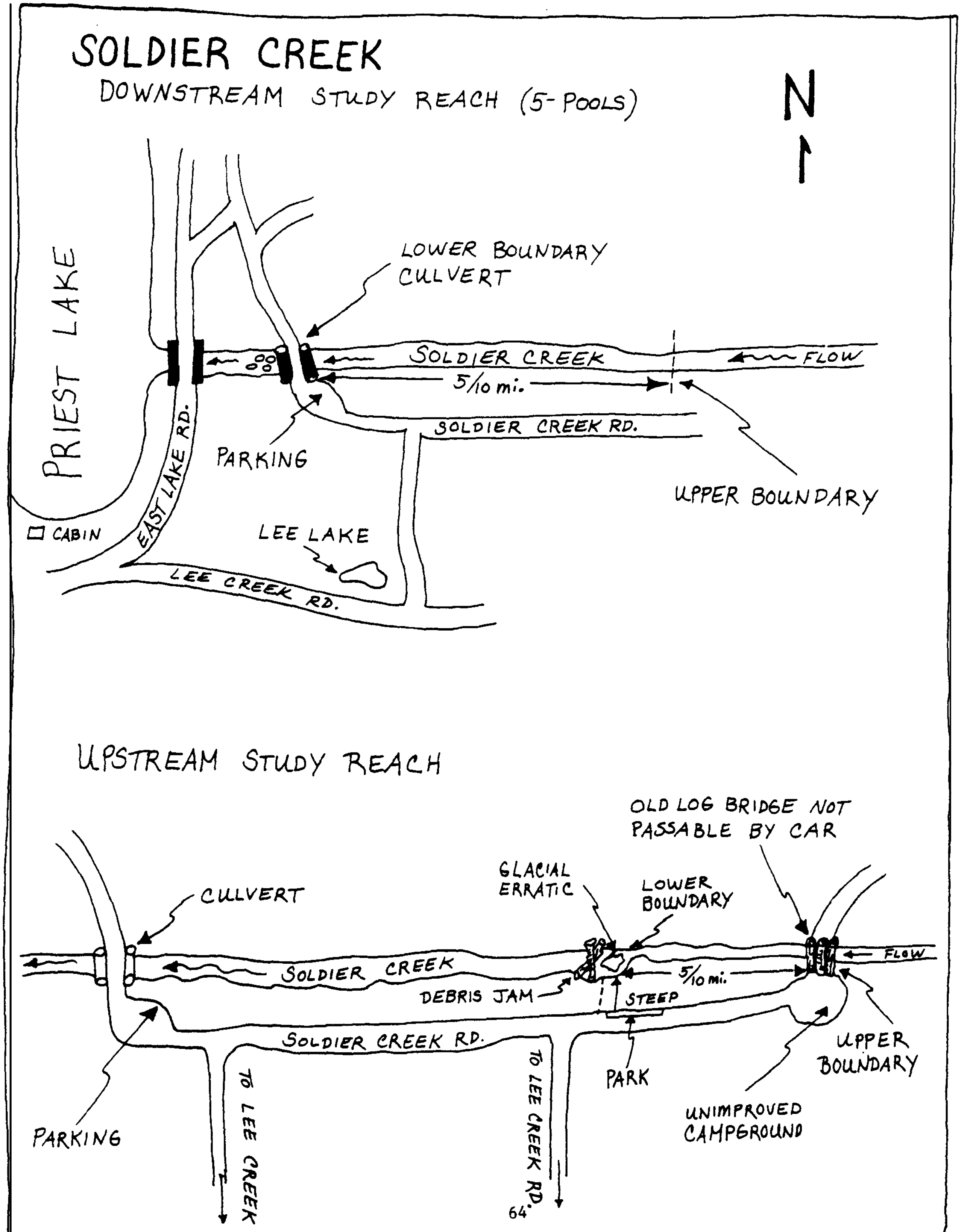
UPSTREAM STUDY REACH (5-POOLS)




KALISPELL CREEK
DOWNSTREAM STUDY REACH (5-POOLS)
N
TO NORDMAN
FLOW KALISPELL CREEK
UPPER BOUNDARY
FS 308
Rt 57
1/4 mi.
LOWER BOUNDARY
UNIMPROVED TRAIL
PRIEST LAKE
FLOW
UPSTREAM STUDY REACH (5-POOLS)
7 mi.
FLOW
KALISPELL CREEK
BRIDGE
USE MOTORCYCLE
FS 2119
HILL
CLOSED GATE
PRIMATIVE CAMPSITE
5/10 mi.
LOWER BOUNDARY
CULVERT
UPPER BOUNDARY
Rt 57
FLOW

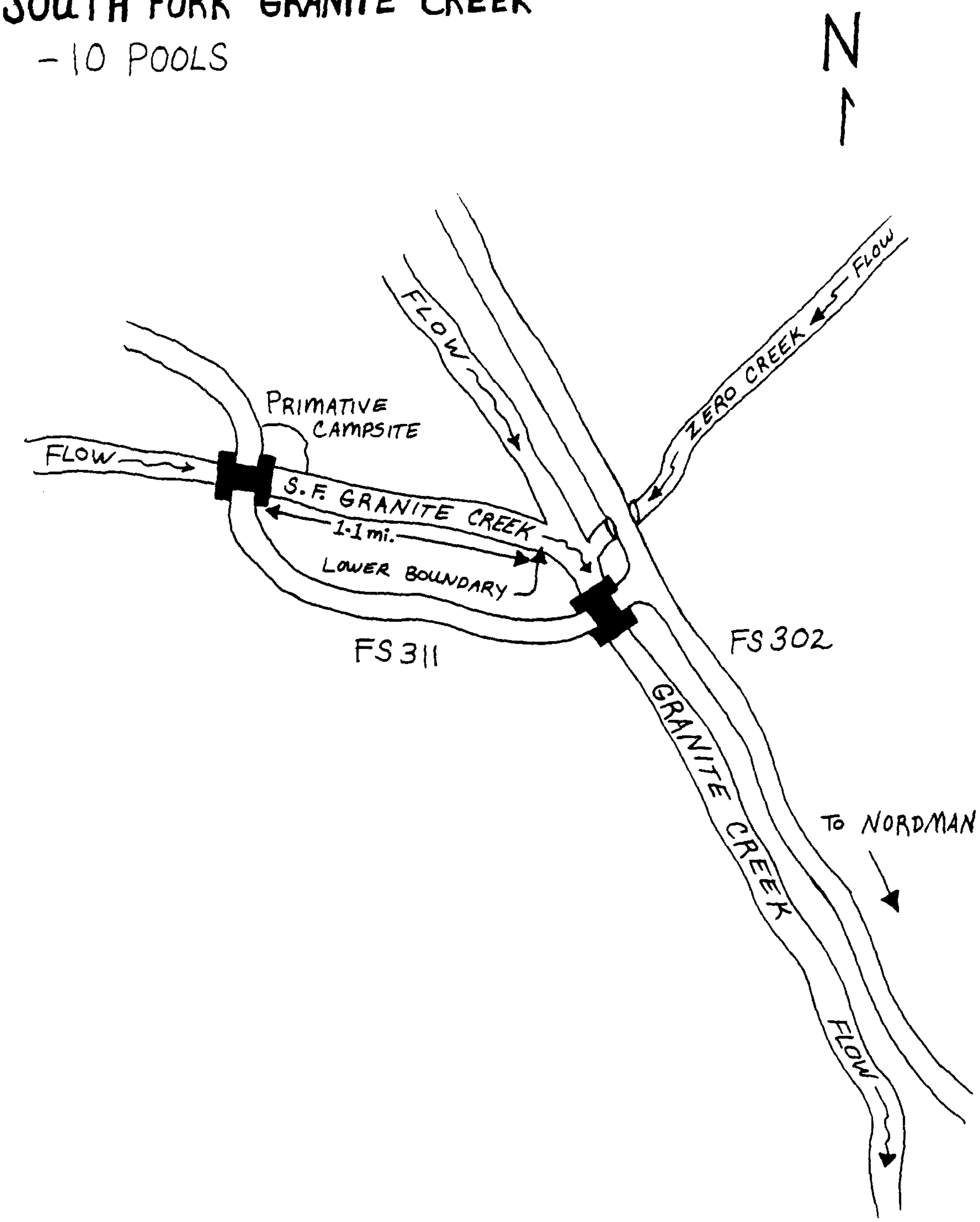

LION CREEK
DOWNSTREAM STUDY REACH (5-POOLS)
N
EAST LAKE ROAD
LUCKY CREEK
FLOW
SECTION 11
SECTION 12
7/10 mi.
LION CREEK — FLOW
1/2 mi.
PRIEST LAKE
LOWER BOUNDARY
(1/2 to 6/10 mi. DOWNSTREAM FROM UPPER BOUNDARY)
LOG BRIDGE
UPPER BOUNDARY
UPSTREAM STUDY REACH (5-POOLS)
LION CREEK ROAD
EAST LAKE ROAD
3.3 mi.
CAMPSITE
1/2 mi.
FLOW
LION CREEK
FLOW
PRIEST LAKE
BRIDGE
LOWER BOUNDARY
LOG BRIDGE
IMPASSABLE TO VEHICLES
(UPPER BOUNDARY)

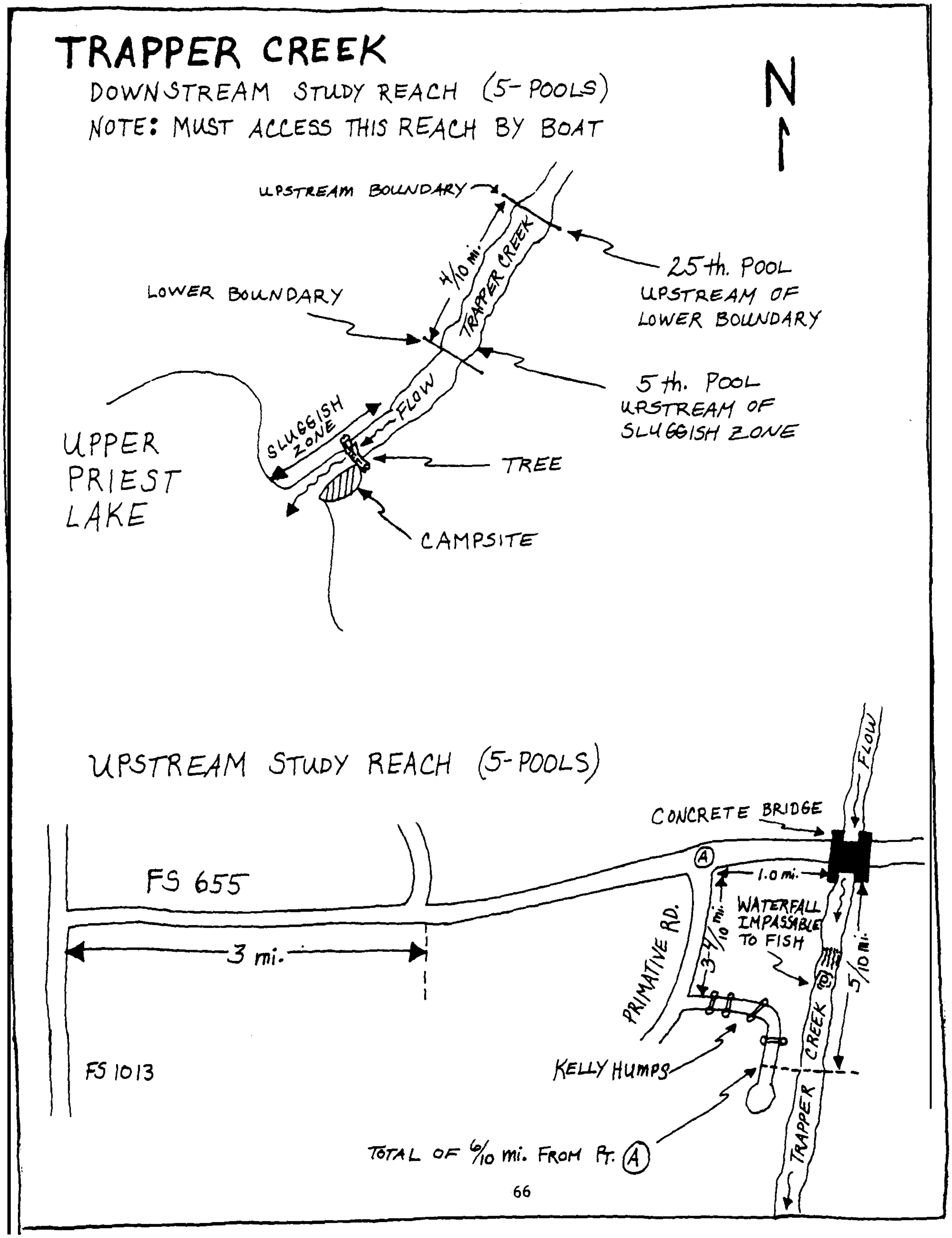

PRIEST RIVER
DOWNSTREAM STUDY REACH (5-POOLS)
N
UPPER BOUNDARY
FLOW
5/10 mi.
3/10 mi
PRIMATIVE CAMPGROUND
LOWER BOUNDARY
FS 1013
UPPER PRIEST RIVER
GRAVEL PIT
UPSTREAM STUDY REACH (5-POOLS)
FLOW
UPPER BOUNDARY
TRAIL # 308
TRAIL HEAD
TRAIL # 317
5/10 mi.
LIME CREEK
FLOW
LOWER BOUNDARY
UPPER PRIEST RIVER
FS 1013

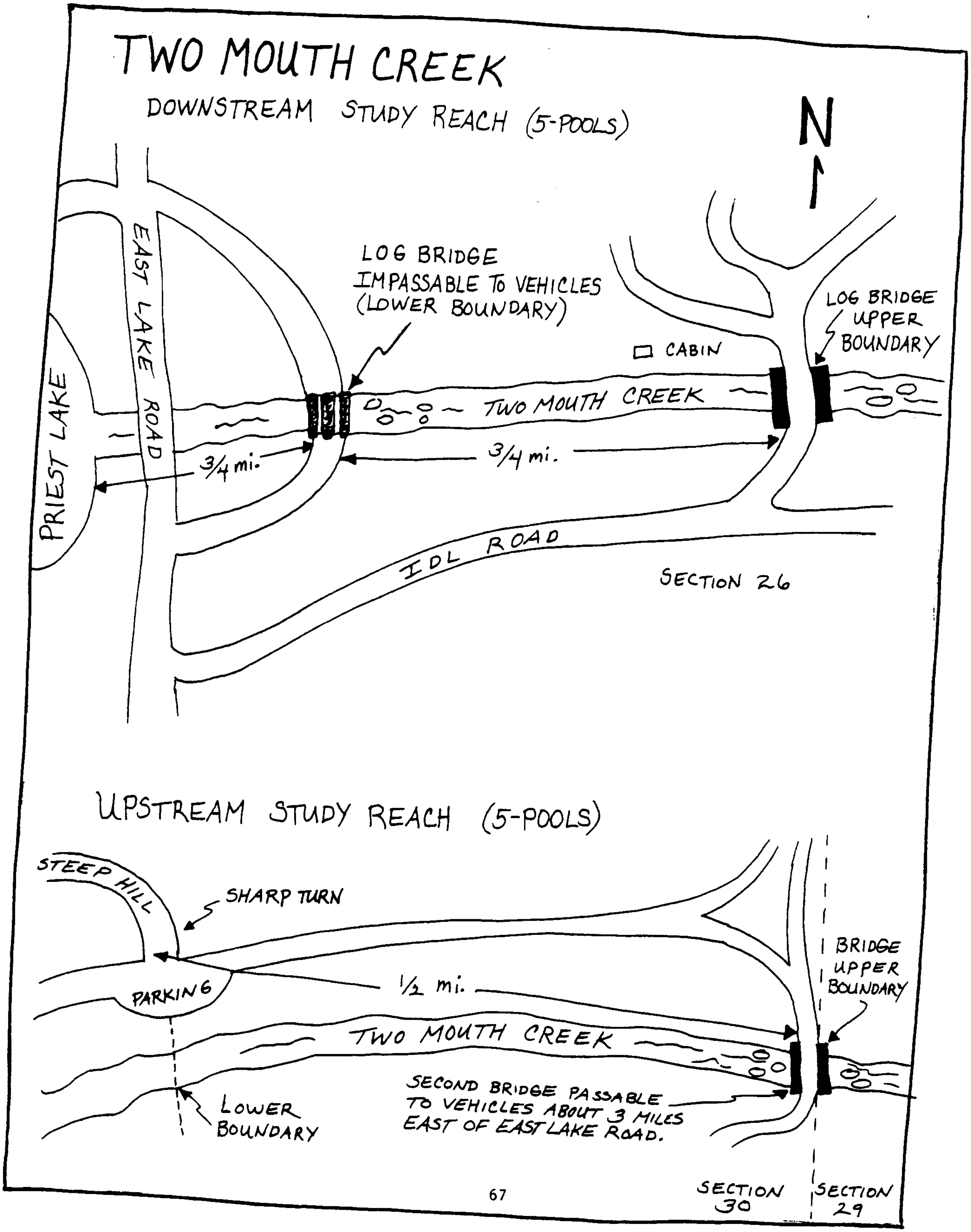

SOLDIER CREEK
DOWNSTREAM STUDY REACH (5-POOLS)
N
PRIEST LAKE
LOWER BOUNDARY CULVERT
SOLDIER CREEK
FLOW
5/10 mi.
SOLDIER CREEK RD.
EAST LAKE RD.
PARKING
UPPER BOUNDARY
CABIN
LEE LAKE
LEE CREEK RD.
UPSTREAM STUDY REACH
OLD LOG BRIDGE NOT PASSABLE BY CAR
GLACIAL ERRATIC
LOWER BOUNDARY
CULVERT
SOLDIER CREEK
FLOW
5/10 mi.
DEBRIS JAM
STEEP
SOLDIER CREEK RD.
TO LEE CREEK
TO LEE CREEK RD.
PARK
UPPER BOUNDARY
UNIMPROVED CAMPGROUND
PARKING

SOUTH FORK GRANITE CREEK

– 10 POOLS




TRAPPER CREEK
DOWNSTREAM STUDY REACH (5-POOLS)
NOTE: MUST ACCESS THIS REACH BY BOAT
N
UPSTREAM BOUNDARY
4/10 mi.
TRAPPER CREEK
25th. POOL
UPSTREAM OF
LOWER BOUNDARY
LOWER BOUNDARY
FLOW
5th. POOL
UPSTREAM OF
SLUGGISH ZONE
SLUGGISH ZONE
UPPER
PRIEST
LAKE
TREE
CAMPSITE
UPSTREAM STUDY REACH (5-POOLS)
FLOW
CONCRETE BRIDGE
A
FS 655
1.0 mi.
PRIMATIVE RD.
3-4/10 mi.
WATERFALL
IMPASSABLE
TO FISH
3 mi.
5/10 mi.
CREEK
FS 1013
KELLY HUMPS
TRAPPER
TOTAL OF 6/10 mi. FROM Pt. A


TWO MOUTH CREEK
DOWNSTREAM STUDY REACH (5-POOLS)
N
LOG BRIDGE
IMPASSABLE TO VEHICLES
(LOWER BOUNDARY)
LOG BRIDGE
UPPER
BOUNDARY
CABIN
TWO MOUTH CREEK
EAST LAKE ROAD
PRIEST LAKE
3/4 mi.
3/4 mi.
IDL ROAD
SECTION 26
UPSTREAM STUDY REACH (5-POOLS)
STEEP HILL
SHARP TURN
PARKING
1/2 mi.
BRIDGE
UPPER
BOUNDARY
TWO MOUTH CREEK
SECOND BRIDGE PASSABLE
TO VEHICLES ABOUT 3 MILES
EAST OF EAST LAKE ROAD.
LOWER
BOUNDARY
SECTION
30
SECTION
29

Submitted by:

R.M. Strach
University of Idaho

T.C. Bjornn
University of Idaho

Approved by:

IDAHO DEPARTMENT OF FISH AND GAME

Jerry M. Conley, Director

Steven M. Huffaker, Chief
Bureau of Fisheries

Virgil K. Moore
Fishery Research Manager